ABSTRACTS OF NORTH AMERICAN GEOLOGY

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

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ABSTRACTS

04428 **Aamot, Haldor W. C.** Heat transfer and performance analysis of a thermal probe for glaciers: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Tech. Rept. 194, 12 p., illus., tables, 1967.

A thermal probe penetrating a glacier requires heat at the hot point for melting as well as along its entire length to balance the radial heat dissipation in the ice and thus prevent freezing in. The heat transfer problem is solved with a LaPlace transform and the results are developed graphically to simplify the numerical calculations. A performance diagram, developed as a design and operating aid, serves for analysis of the anticipated penetration performance of the probe and the required power levels.—Author's summary

04496 **Abbott, D.** Heavy minerals in glacial deposits of the Bathurst area: Mining in Canada, Sept., p. 19–23, illus., tables, 1967.

Glacial till over mineralized bedrock was sampled. No correlation was found between bedrock mineralization and samples.—ARK

04584 **Abelson, Philip H.** (editor). Researches in geochemistry, V. 2: New York, John Wiley and Sons, 663 p., illus., tables, 1967.

The book contains 23 chapters by 30 authors, each reviewing the present status of research in one specific area, describing the author's recent contributions, and containing a bibliography. Some chapters update topics treated in Volume 1, 1959—geochronology, oxygen isotope geology, and sulfide studies; about half the chapters are devoted to subjects not touched in the earlier volume. New studies created by instrumentation form five chapters. The space age has created new interest in meteorites and three chapters are devoted to these; two deal with the ocean floor. All chapters but one are cited separately.—ESL

04587 **Abelson, Philip H.** Conversion of biochemicals to kerogen and *n*-paraffins, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 63–86, illus., tables, 1967.

Two areas are discussed: the chemical reactions that take place in sediments rich in organic matter, and the relationship between petroleum and kerogen. The types of reactions seen in pigment studies are described. Processes giving rise to kerogen, and eventually to petroleum hydrocarbons, are more complex. Discussion of major steps in the conversion of living matter to petroleum includes examination of distribution of fatty acids and other long straight-chain alkyls in biological materials, of processes in conversion of biochemicals to kerogen, of occurrence of small amounts of fatty acids in sedimentary rocks, and of production of hydrocarbons from kerogen in the laboratory and in nature.—ESL

Adam, Eleanor K. *See* Guilday, John E. 04704

04473 **Adegoke, Oluwafeyisola S.** A probable pogonophoran from the early Oligocene of Oregon: Jour. Paleontology, v. 41, no. 5, p. 1090–1094, illus., 1967.

A problematic group of elongate, tubular fossils, occurring in association with "moderately" deep-water invertebrates from the Lower Oligocene shales of the

Keasey Formation in Oregon is described as *Adekunbiella durhami* n. gen., n. sp. The phyletic position and affinities of the fossils are at present uncertain. However, the totality of morphologic traits suggests a likely relationship to pogonophorans.—*fom* Author's abstract

04615 **Agenbroad, Larry Delmar.** Cenozoic stratigraphy and paleo-hydrology of the Redington-San Manuel area, San Pedro Valley, Arizona [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 737B, 1967.

04709 **Ageton, Robert W.** Stress ellipsoid determination in a rock-burst-prone area at a 4,000 foot depth, Galena mine, Wallace, Idaho: U.S. Bur. Mines Rept. Inv. 6997, 23 p., illus., tables, 1967.

Strains resulting from relief of external stress by overcoring were measured in three mutually perpendicular drill holes penetrating quartzite veined by siderite. The elastic constants were estimated using a biaxial tester on the overcores, and by uniaxial static loading of standard 1-inch-diameter oriented cores. Computed principal stresses were -13,000 psi oriented about N. 45°W. and nearly horizontal, -11,000 psi plunging about 60° to N. 45° E., and -7,000 psi plunging about 30° to S. 45° W. The high lateral stresses detected may have been a factor in a subsequent rock-burst about 100 feet northwest of the test site.—KFF

04302 **Albee, Howard F.; Jobin, Daniel A.; Schroeder, Marvin L.** Northwesterly extension of the Darby thrust in the Snake River Range, Wyoming and Idaho, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D1-D3, illus., 1967.

The Darby thrust lies along the eastern edge of the Wyoming Range in western Wyoming and in the Snake River Range, Idaho. Earlier workers thought that the fault terminated in a north-plunging anticline on the east side of Munger Mountain about 2 1/2 miles north of the Snake River, but recent mapping has shown that the Darby thrust extends 27 miles northwest of Munger Mountain and, thus, that the fault is at least 127 miles long. In general, Lower Cretaceous rocks are thrust over Upper Cretaceous rocks along the newly mapped segment of the fault. Near Munger Mountain, however, the only exposed rocks involved in the thrust are the Aspen Formation of Early Cretaceous age.—Authors' abstract

04672 **Alexander, E. C., Jr.; Manuel, O. K.** Isotopic anomalies of krypton and xenon in Canyon Diablo graphite: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 220-224, tables, 1967.

The abundance and isotopic composition of xenon and krypton have been determined in Canyon Diablo graphite. Large excesses of Kr-80, Kr-82 and Xe-128 are attributed to neutron capture on bromine and iodine. The graphite contains one of the largest excesses of Xe-129 observed in meteoritic xenon. The xenon spectra do not display the 'general anomaly pattern' which characterizes xenon in chondrites.—Authors' abstract

04616 **Alker, Julius.** Review of the North American fossil cricetine rodents (Muridae: Mammalia) [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 737B-738B, 1967.

04513 **Allen, E. P.** A newly discovered petrified wood locality near Fayetteville, North Carolina [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 178-179, 1967.

Anderson, Duwayne M. *See* Low, Philip F. 04396

04346 **Anderson, Orson L.; Soga, Naohiro.** A restriction to the law of corresponding states: Jour. Geophys. Research, v. 72, no. 22, p. 5754-5757, illus., 1967.

New experimental data are reported which suggest that the law of corresponding states appears to arise from classification of oxide compounds on the basis of a somewhat common value of mean atomic weight, irrespective of valence and electronic structure; when classified in the ordinary sense of chemical physics the more common laws disappear. Thus, there is no fundamental conflict between

chemical physics and the law of corresponding states. For problems of the Earth's interior, where there is a restriction of compounds to a rather common value of mean atomic weight, the law of corresponding states becomes significant. Ca is now excluded except insofar as it is a minor constituent of oxide compounds. At present it is not clear whether oxide compounds containing Fe belong to the law of corresponding states or not.—DBV

04827 **Anderson, Roy A.** Graben structure in the Coeur d'Alene district, Idaho: Econ. Geology, v. 62, no. 8, p. 1092–1094, 1967.

It is suggested that the district structure was developed by slumping of semi-consolidated sediments along a late Precambrian rift graben. Evidence is deep synclines with adjacent anticlines overturned toward each other, minor slump features, a possible quickstone breccia, and hydrothermal activity.—WSW

Argun-Weston, A. *See* Innes, M. J. S. 04684

04630 **Ashley, Roger Parkmand.** Metamorphic petrology and structure of the Burnt River Canyon area, northeastern Oregon [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 1, p. 230B–231B, 1967.

04617 **Asquith, George Benjamin.** The marine dolomitization of the Mifflin Member, Platteville Limestone in southwest Wisconsin [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 738B, 1967.

04556 **Asseez, Liadiyu Olayinka.** Stratigraphy and paleogeography of the Lower Mississippian sediments of the Michigan Basin [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 937B, 1967.

04601 **Atallah, Nicolas Jamil.** The hydrologic balance to a two-aquifer system under integrated use of surface and ground water [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 666B, 1967.

04673 **Aumento, F.** Magmatic evolution on the Mid-Atlantic Ridge: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 225–230, illus., 1967.

A model based on recent field and experimental evidence explains the generation and characteristics of basalts found on the Mid-Atlantic Ridge. Multiple cycles of partial melting of the upper mantle, related to tectonic patterns beneath the axis of the Ridge, generate the different magma types. Sudden stress releases due to faulting on the Median Rift Valley result in considerable partial melting of a pyrolite mantle, which initiates a volcanic cycle with subsequent extrusion of tholeiitic lava. As the original energy is consumed, the extent of partial melting possible is reduced, so that smaller quantities of magma, progressively enriched in alkalis, are generated. Since the magmas extrude onto an actively spreading ocean floor, there results a distribution of different basalt types which can be correlated to topographic features of the Median Rift Valley.—Author's abstract

Bachinski, D. *See* Kanehira, K. 04632

04310 **Bachmat, Y.** On the similitude of dispersion phenomena in homogeneous and isotropic porous mediums: Water Resources Research, v. 3, no. 4, p. 1079–1083, 1967.

A procedure of simulating, by a physical model, dispersion of a solute in ground water flowing through a homogeneous and isotropic aquifer is considered. Ground water is a solution of variable density and viscosity owing to variations of solute concentration. The model has a very restricted application because of the required simultaneous invariancy of four nondimensional criteria of similitude: a macroscopic Reynolds number, a macroscopic Peclet number, the geometrical similarity of the medium, and physicochemical similarity of the solution. However, at certain conditions common in practice, some of those criteria can be waived, and the model becomes a useful device for solution of field problems. These conditions occur in the range of validity of Darcy's law, at relatively high Peclet numbers, and at very small variations of relative solute concentration.—*from* Author's abstract

04852 **Back, William; Hanshaw, Bruce B.** Hydrogeology of the northern Yucatán Peninsula, Mexico, *in* Yucatan field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7: New Orleans, La., New Orleans Geol. Soc., p. 64–78, illus., tables, 1967.

The Yucatán Peninsula is similar to Florida in its thick sequences of flat Tertiary limestones and abundant but shallow ground water. Due to lack of soil cover in northern Yucatán, rain infiltrates rapidly without surface drainage, and in this karst area, great sinks and caves form reservoirs; some were sites for waste disposal or sacrifices by the ancient Mayans. In the higher, more tropical southern part, shallow depressions, naturally sedimented or lined with clay by Mayan slaves, ponds perch above the water table; in city centers aqueducts and cisterns were developed. Many homes have dual dug wells, one drawn by windmill, the other for waste disposal. Chemical analyses show the resulting contamination, as well as salt-water intrusion and limestone solution effects. A safer modern system is being developed.—GDC

04648 **Balbach, Margaret Kain.** Paleozoic lycopsid fructifications—[Pt.] 3, Conspecificity of British and North American *Lepidostrobus* petrifactions: Am. Jour. Botany, v. 54, no. 7, p. 807–875, illus., 1967.

Thirty Middle Pennsylvanian coal-balls from Illinois and Kansas have microsporangiate cones of *Lepidostrobus*. Numerical analyses show that they do not vary significantly from other genera and species and that all are probably synonymous. *Lepidostrobus coulteri, L. pulvinatus, L. pelosus*, and *Lepidocarpon magnificum* (microsporangiate form) are all conspecific with the British *Lepidostrobus oldhamius* (by priority). The megasporangiate *Lepidocarpon lomaxi* may also be conspecific because it is found with the others.—HRC

04763 **Baldwin, Arthur Dwight, Jr.** Geologic and geographic controls upon the rate of solute erosion from selected coastal river basins between Half Moon Bay and Davenport, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 937B–938B, 1967.

04554 **Balgord, William Dwyer.** Crystal chemical relationships in the analcite family and a study of cation-H_2O coordination in certain synthetic and natural zeolites [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 1103B, 1967.

04488 **Balster, C. A.** Geology of the southern Tobacco Root Mountains, Madison County, Montana, *in* Centennial basin of southwest Montana—Montana Geol. Soc., 18th Ann. Field Conf. 1967, Guidebook: [Billings, Mont.] Montana Geol. Soc., p. 89–92, 1967.

The southern Tobacco Root Mountains are characterized by Precambrian rocks, which are the product of medium- to high-grade metamorphism of both sedimentary and igneous rocks. Several episodes of igneous intrusion are represented by basic to acidic dikes and sills and a batholithic body of quartz monzonite. Pegmatite bodies and quartz veins criss-cross the country rock and are probably related to the mineralization of the area. Topographic form of the mountain is probably strongly related to rotated fault blocks.—Author's summary

04410 **Baltz, Elmer H.; West, S. W.** Ground-water resources of the southern part of the Jicarilla Apache Indian Reservation and adjacent areas, New Mexico: U.S. Geol. Survey Water-Supply Paper 1576-H, p. H1–H89, illus., tables, geol. map, 1967.

The area, in the central San Juan Basin, is bounded on the east by the French Mesa-Gallina and Nacimiento uplifts. Of Cretaceous rocks, the Mesaverde Group might yield potable water at shallow depth along the east side, but most rocks are deeply buried and contain saline water; other formations either do not yield potable water to wells or contain saline water and natural gas. The Paleocene Ojo Alamo Sandstone is an important aquifer in the southern part, and generally the deepest; the Nacimiento yields water to wells in a few places and may be a potential source from deep wells. Sandstone beds in all members of the Eocene San Jose Formation yield water to wells and some have considerable potential. Small amounts of water are obtainable from Tertiary or Quaternary gravel and alluvium. Quality of water

varies widely. Calculated potential yield of deep wells suggests test drilling is warranted.—*from* Authors' abstract

04330 **Bandy, Orville L.** Foraminiferal definition of the boundaries of the Pleistocene in southern California, U.S.A., *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 27–49, illus., 1967.

Cores from the Los Angeles Basin and offshore basins of southern California were examined for changes in marine microfaunas marking the beginning and end of the Pleistocene, as recognized by influx and retreat of colder-water faunas. The Pleistocene–Recent boundary, about 11,000 yr B.P., is marked by a shift from sinistral to dextral populations of *Globigerina pachyderma*, by appearance of dextral *G. subcretacea*, and by increases in numbers of orbulina chambers and in abundance of radiolarians. The Pliocene–Pleistocene boundary, >3 m.y. B.P., is marked by a shift from dextral to sinistral *G. pachyderma*. Paleobathymetric determinations at this boundary in the Los Angeles Basin show that a differential bottom topography existed, with different groups of benthic foraminiferal indices which vary several hundred meters stratigraphically from the *G.pachyderma* time line.—VMJ

04331 **Bandy, Orville L.; Wade, Mary E.** Miocene–Pliocene–Pleistocene boundaries in deep-water environments, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 51–66, illus., 1967.

The DEHISCENS DATUM (appearance of the foraminifer sphaeroidinella dehiscens, not a valid genus or species) is recognized as marking the Miocene Pliocene boundary, about 9 m.y. B.P., in deep-sea sediments in the Philippines, western Atlantic Ocean off Brazil, southern California, and elsewhere. The MENARDII REDUCTION DATUM (disappearance of dextral forms of *Globorotalia tumida menardii*) marks the Pliocene–Pleistocene boundary, about 3 m.y. B.P. The Miocene–Pliocene boundary is also marked by upper limits of all *Sphaeroidinellopsis* and several *Globoquadrina* species and *Globorotalia tumida miocenica*, by a vast reduction in abundance of discoasters, and by appearance of *G. inflata* and *G. truncatulinoides*. *G. tumida multicamerata* has an upper limit within the Lower Pliocene or perhaps at its upper boundary.—VMJ

04564 **Bank, Evelyn Ruth Jastram.** A study of the transformation of sphalerite to wurtzite in atmospheres of zinc and sulfur [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 823B, 1967.

Banks, Harlan P. *See* Bonamo, Patricia M. 04342

Barany, R. *See* King, E. G. 04728

04476 **Bardack, David.** Did some Cretaceous teleosts described by Cope as North American actually come from Lebanon?: Jour. Paleontology, v. 41, no. 5, p. 1274–1276, illus., table, 1967.

Seven species of teleosts were described by Cope from the Niobrara Cretaceous of Dakota. These fishes are taxonomically identical with fishes from the Cretaceous of Lebanon in western Asia. Study of clay minerals and foraminifera from matrix containing the Cope fishes, Lebanon fishes, and in matrix from selected sites in South Dakota suggest that Cope's specimens did not come from North America. – Author's abstract

04761 **Bariss, Nicholas.** Effects of source relations upon loess topography [abs.]: Nebraska Acad. Sci. Proc., 77th Ann. Mtg., p. 35, 1967.

04731 **Barnes, H. L.; Romberger, S. B.; Stemprok, M.** Ore solution chemistry—[Pt.] 2, Solubility of HgS in sulfide solutions: Econ. Geology, v. 62, no. 7, p. 957–982, illus., tables, 1967.

Experimental data, theoretical calculations, and comparison with active hot springs depositing cinnabar (California and Nevada) indicate that transport of cinnabar as

sulfide or bisulfide complexes is possible in the range 100°–200°C in neutral or weakly alkaline aqueous solutions. Any of the following processes can prompt deposition: decrease in temperature, pressure, or pH; oxidation; dilution.—WSW

04716 **Baur, W. H.; Rao, B. Rama.** The crystal structure of metavauxite: Naturwissenschaften, v. 54, no. 21, p. 561, tables, 1967.

Metavauxite structure is interesting as an example of a novel kind of polyhedron linkage in an orthophosphate hydrate. The crystals are monoclinic with $a=10.22$, $b=9.56$, $c=6.94$ A, $\beta=97.9°$, $Z=2$, and space group P $2_1/c$. The formula should be $[AlPO_4OHOH_2]_2[Fe(OH_2)_6]$.—ESL

Bé, Allan W. H. *See* McIntyre, Andrew. 04319

04602 **Beaver, Albert John.** Characteristics and genesis of some bisequal soils in eastern Wisconsin [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 426B, 1967.

04547 **Beck, S. L.** Uranium in Saskatchewan, present and future: Western Miner, v. 40, no. 10, p. 40–50, illus., 1967.

Several hundred occurrences of pitchblende are known in the Athabaska area of Saskatchewan. Ore is in a Precambrian basement complex that was metamorphosed 1700–1800 m.y. ago. Isoclinal folds trend northeast. Ore consists of vein-type deposits, of pitchblende in faults, and of syngenetic uraninite in pegmatite, gneiss, and migmatite. Deposits have been reworked or rejuvenated several times, and as recently as 190 m.y. ago. Distribution of uranium is controlled by regional structure.—ARK

04733 **Becker, Robert M.; Hooker, Verne E.** Some anisotropic considerations in rock stress determinations: U.S. Bur. Mines Rept. Inv. 6965, 23 p., illus., 1967.

In situ stress is commonly calculated from measurements of the change in diameter of a borehole upon relief of external stresses by overcoring. In order to avoid errors resulting from the common but often erroneous assumption that the rock is isotropic the authors advocate a triaxial testing procedure wherein the elastic constants are determined by measurements of the lateral and transverse strains produced in a section of the overcore under axial load. The direction and magnitude of the in situ biaxial stresses can then be evaluated using an adaptation of Kawamoto's solution of plain stress about a circular hole in an orthotropic medium. The procedure is illustrated with a numerical example.—KFF

Beiser, Arthur. *See* Krauskopf, Konrad B. 04420

04682 **Béland, J.** Contributions from systematic studies of minor structures in the southern Québec Appalachians, *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 48–56, illus., table, 1967.

Gross features of regional structure and stratigraphy of the western part of the Eastern Townships are outlined as a framework for a review of studies of foliations, lineations, and minor folds in this region (Osberg, 1965; Römer, 1961; Rickard, 1965; Baer, 1961). These studies indicate that the region has undergone several phases of deformation; relation of these phases to the Taconic and Acadian orogenies can be inferred to some extent from unconformities and isotopic dating of metamorphic minerals. The early folding was apparently recumbent, variable in trend, possibly related to gravitational movement; in contrast, the late folding is upright, consistently oriented, probably induced by compressive tangential stresses. Cleavage domes in Stoke Range anticline are tentatively ascribed to diapiric rise of granitoid bodies late in the Acadian orogeny.—VMJ

04580 **Bell, P. M.; England, J. L.** High-pressure experimental techniques, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 619–638, illus., table, 1967.

Discussion on the single stage piston and cylinder is divided into temperature–pressure calibration, and design and modifications for special applications. Two-stage pressure apparatus, anvil apparatus, simple squeezer, belt apparatus, multi-anvil apparatus, and liquid and gas pressure apparatus are described also.—ESL

04636 **Bemben, Stanley Michael.** The influence of controlled strain restraints on the strength and behavior during shear of a sand tested with a constant volume [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 1, p. 167B, 1967.

04833 **Benson, Richard H.** Ecology of Rhizopoda and Ostracoda of southern Pamlico Sound region, North Carolina—Pt. 2, History and microfauna of southern "Outer Banks" and offshore region: Kansas Univ. Paleont. Contr. 44, Ecology, art. 1, p. 82–90, illus., table, 1967.

The sands of the offshore islands come from the north and not the adjacent land to the west. Wind action is strong, deflation basins being common and are in turn altered by the currents and marine scouring during periods of water level differences between the estuaries and the ocean. Change is common; stability is not. Cores from the offshore islands and the adjacent lagoons show that the lagoon deposits are biostratigraphically disappointing; leaching is a possibility save for abundant *Elphidium* (calcareous Foraminifera). In general, the paucity of the fauna prevented ancient biofacies from being recognized. Offshore samples of bottom sediments and fauna show contamination from offshore fossiliferous outcrops are not important.—HRC

Beran, R. J. *See* Watson, G. S. 04400

04418 **Bermudez, Pedro J.; Seiglie, George A.** A new genus and species of foraminifer from the early Miocene of Puerto Rico: Tulane Studies Geology, v. 5, no. 3, p. 177–179, illus., 1967.

Riveroinella martinezpicoi, a new genus and species, from the base of the Ponce Formation, is described and illustrated. It occurs in a bed of *Globigerina* ooze with a high content of a black mineral, is in the early Miocene *Globigerinella insueta* zone, and is a member of the Family Ceratobuliminidae. It is distinguished from the other genera in the family by the planispiral test, aragonitic wall, peripheral aperture, and alternating inflated and plane sides in successive chambers.—HRC

Berry, William B. N. *See* Harwood, David S. 04304

04535 **Bhattacharji, Somdev.** Scale model experiments on flowage differentiation in sills, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 69–70, illus., 1967.

A model with various solid–fluid mixtures was used to verify the hypothesis that the phenocryst-rich central core of a sill might be formed by the concentration of intratelluric crystals toward the center of the flowing magma. Models were made for ultramafic sills 5 to 2,000 feet thick, with feeder dikes. Various viscous fluids and solids were used to represent olivine, pyroxene, and plagioclase in a magma. Lucite plastic was used to represent layers of the sill. It is clear that the solids became concentrated in the center, thus verifying the theory.—HRC

04700 **Bickel, David.** Preliminary checklist of Recent and Pleistocene Mollusca of Kentucky: Sterkiana, no. 28, p. 7–20, 1967.

The list of 114 bivalves, 20 aquatic pulmonates, 39 freshwater prosobranchs, and 155 land snails and slugs, contains only published records; no new records are included, nor has any attempt been made to verify records. Species from nearby states are included with a query as are possible errors in the records. The bibliography is not complete, the 20th Century record being stressed. In most cases, the generic nomenclature is quite conservative.—HRC

Biggar, G. M. *See* Wyllie, P. J. 04338

04637 **Bischoff, James Louden.** The kinetics of crystallization of calcite and aragonite [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 1, p. 231B, 1967.

04448 **Bladel, Robert Van; Laudelout, Henri.** Apparent irreversibility of ion-exchange reactions in clay suspensions: Soil Sci., v. 104, no. 2, p. 134–137, illus., 1967.

This paper describes an experimental design in ion-exchange studies which affords a convenient way of eliminating errors in the estimation of equilibrium solution composition due to imperfect attainment of equilibrium or apparent irreversibility of the exchange reaction. This design also makes it unnecessary to estimate activity coefficients in mixed electrolytes solutions.—JWH

04734 **Blake, Wilson.** Stresses and displacements surrounding an open pit in a gravity-loaded rock: U.S. Bur. Mines Rept. Inv. 7002, 20 p., illus., tables, 1967.

A finite element mathematical model of stress distribution through a vertical section of an open pit in gravity-loaded rock was solved by an iterative computer technique. The magnitude of the stress along the pit boundary is low, although local stress concentrations occur at irregularities, reaching a maximum concentration of 5.5 at the top bench, but even here the magnitude of the stress is only 171 psi compression. Thus the stresses induced in a gravity loaded continuous competent rock by open pitting are not a primary cause of slope failure. The addition of a small horizontal stress field creates significant increase in stress magnitude and stress concentration at the bottom of the pit, and introduces tensile stresses in the upper part of the pit.—KFF

04618 **Bock, Wayne Dean.** Monthly variation in the foraminiferal biofacies on *Thalassia* and sediment in the Big Pine Key area, Florida [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 738B, 1967.

04646 **Boettscher, A. L.; Wyllie, P. J.** Hydrothermal melting curves in silicate-water systems at pressures greater than 10 kilobars: Nature, v. 216, no. 5115, p. 572–573, illus., 1967.

Water-saturated univariant melting curves have been extended into the system $NaAlSiO_4$–SiO_2–H_2O from 10 to 35 kb, using piston-cylinder apparatus. None of the curves showed a temperature minimum where $dT/dP=0$, as predicted by several authors. The results show that the slopes of hydrothermal melting curves for silicates can change from negative to positive at high pressures, but in the system studied the change is imposed by phase transitions involving a large volume decrease rather than by a progressive change in the properties of water in liquid and vapor phases. This means that temperatures at which silicate rocks in the presence of water begin to melt continue to decrease with increasing pressure throughout the thickness of the Earth's crust.—DBV

Bogue, Robert D. *See* Gilliam, Jeanne A. 04858

04342 **Bonamo, Patricia M.; Banks, Harlan P.** *Textraxylopteris schmidti*—Its fertile parts and its relationships within the Aneurophytales: Am. Jour. Botany, v. 54, no. 6, p. 755–768, illus., 1967.

Material from the Devonian Oneonta Formation in Greene County, New York, shows the fertile system branches to be composed of successive nodes bearing opposite and decussately arranged, upcurved sporangial complexes, of which details are described. The spores are identical to *Rhabdosporites langii* and are 75–176 microns in diameter. The diagnosis of the genus and species are emended and the Order Aneurophytales is redefined.—HRC

04867 **Boneham, Roger F.** Devonian *Tasmanites* from Michigan, Ontario, and northern Ohio: Michigan Acad. Sci., Arts and Letters Papers 1966, v. 52, p. 163–172, illus., 1967.

The occurrence of *Tasmanites* forms and their value as stratigraphic markers for the various rock units of the Middle and Upper Devonian formations was investigated. Derivation of the nomenclature from the original *Sporangites* is

reviewed. Wall (1962) concluded that *Tasmanites* was probably a group of marine green algae. Four samples were collected along Lake Huron in Ontario, eight from Michigan along Lakes Huron and Michigan, and eight from northern Ohio. The Ipperwash Limestone in Ontario was the only Middle Devonian formation to contain *Tasmanites*, but many of the Upper Devonian black shales contained significant quantities; the distribution is tabulated. No zonation was distinguished, and the shales could not be correlated using *Tasmanites*. Nine species are illustrated and systematic descriptions given.—ESL

04720 **Bonet, F.; Butterlin, J.** Stratigraphy of the northern part of the Yucatán Peninsula, *in* Yucatán field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7: New Orleans, La., New Orleans Geol. Soc., p. 52–57, reprinted 1967; originally published 1962.

04825 **Bonet, F.; Butterlin, J.; Murray, Grover E.; Weidie, A. E., Jr.** Geologic road log, Merida to Puerto Juarez, *in* Yucatán field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7: New Orleans, La., New Orleans Geol. Soc., p. I–VIIa, illus., reprinted 1967; originally published 1962.

Bonilla, Manuel G. *See* Mullineaux, Donal R. 04389

04619 **Bonis, Samuel B.** Geologic reconnaissance of the Alta Verapaz fold belt, Guatemala [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 739B, 1967.

04334 **Borst, Roger Lee.** A mineralogical study of some Helderberg rocks of the central Hudson Valley, New York [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 1, p. 232B, 1967.

Bortz, Louis C. *See* Murray, D. Keith. 04701

04575 **Boström, Kurt.** The problem of excess manganese in pelagic sediments, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 421–452, illus., tables, 1967.

Sources of manganese which have been suggested are: weathering on continents, submarine weathering of volcanic products, debouching hydrothermal exhalations, and diffusion of manganese through the sediments from deeply buried strata. Attempts have been made to solve the problem by means of geochemical balances, and it is proposed that the occurrence of excess manganese is mainly an effect of redistribution processes in connection with volcanic and metamorphic events at depth. Most of the manganese mobilized by these processes is derived from the continent. Preferential leaching of manganese explains the manganese–iron ratios found. The relative efficiencies of types of volcanic and metamorphic events is discussed. It seems that deeper sediments in areas of high heat flow would lose more manganese than other deeply buried sediments.—ESL

Botbol, Joseph M. *See* Nackowski, M. P. 04851

04463 **Botz, M. K.** Hydrogeology of the East Bench Irrigation Unit, Madison and Beaverhead Counties, Montana, *in* Centennial basin of southwest Montana—Montana Geol. Soc., 18th Ann. Field Conf. 1967, Guidebook: [Billings, Mont.] Montana Geol. Soc., p. 79–88, illus., tables, 1967.

The Clark Canyon reservoir is used to irrigate 28,000 acres in the Dillon–Twin Bridges area. The effect of irrigation on the ground water pattern in the area is investigated. Tertiary sedimentary rocks and Recent alluvium are the chief aquifers. The former are recharged by the irrigation water primarily, with very little from rain and snowmelt. The ground water is insufficient for irrigation. The gradient of the ground water is toward the Beaverhead River from 20 to 120 feet per mile. Graphs show the results of pumping tests, and chemical analyses are given in tables. The water varies from hard to very hard, calcium and magnesium bicarbonate being the chief offenders.—HRC

04472 **Boucot, A. J.; Johnson, J. G.** Species and distribution of *Coelospira* (Brachiopoda): Jour. Paleontology, v. 41, no. 5, p. 1226–1241, illus., 1967.

The atrypid brachiopod genus *Coelospira* appeared first in the Silurian Ludlow age Brownsport Formation, in the form of *C. saffordi*, a fully differentiated member of the genus. Late Llandovery age homeomorphs listed as *Zygospira* in a broad sense may be ancestral to *Coelospira*, but none shows a satisfactory combination of intermediate characters. One new Silurian species, *Coelospira kennethensis*, is named. Silurian and Devonian species have mutually distinct morphology, expressed externally by different rib patterns. Internally, Silurian species bear small ventral diductor scars on an apical platform; in Devonian species diductor scars are long and essentially independent of a ventral platform. Silurian species have nearly a world-wide distribution, but Devonian are restricted to the Western Hemisphere with the exception of a specimen from Turkey.—*from* Author's abstract

Boucot, Arthur J. *See* Carlson, Marvin P. 04468

04579 **Boyd, F. R.** Petrological problems in high-pressure research, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 593–618, illus., 1967.

Some of the rocks now in the crust were generated in the mantle so that work in the pressure range above 10 kb is of great interest. The kyanite-sillimanite-andalusite stability fields, calcite-aragonite transition, ultramafic systems, calc-silicate equilibrium, pyroxenes, and experiments on basalt and eclogite are topics in high-pressure research selected for discussion.—ESL

04303 **Brabb, Earl E.; Churkin, Michael, Jr.** Stratigraphic evidence for the Late Devonian age of the Nation River Formation, east-central Alaska, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D4–D15, illus., 1967.

The stratigraphic position and age of the Nation River Formation have long been controversial problems, primarily because previous workers failed to recognize an unconformity at the base of the overlying Tahkandit Limestone of Permian age at the type locality of these formations near the mouth of the Nation River. In the vicinity of McCann Hill and the Tatonduk River, the Nation River Formation is stratigraphically above shale and chert of the McCann Hill Chert of Early, Middle(?), and Late Devonian age and below similar rocks of Late Devonian to Mississippian age, and thus by superposition is no older than Middle Devonian and no younger than Late Mississippian. Spores collected from the Nation River Formation at 18 localities throughout its type area and elsewhere corroborate the stratigraphic evidence and indicate that the formation is almost certainly Late Devonian.—Authors' abstract

04873 **Brace, C. Loring.** The stages of human evolution: Englewood Cliffs, N. J., Prentice-Hall, 116 p., illus., table, 1967.

The book is divided into two sections, the first of which traces the discovery of the evidence of man's evolution, the men connected with it, and theories developed at various stages. Part 2 deals with interpretation of the evidence. Evolutionary principles discussed are natural selection, mutation effect, genetic drift, orthogenesis, and man's adaptation. Four stages, the Australopithecine, Pithecanthropine, Neanderthal, and Modern are considered. A graphic representation of the major changes is given in an epilogue.—ESL

04415 **Bramlette, M. N.; Wilcoxon, J. A.** Middle Tertiary calcareous nannoplankton of the Cipero section, Trinidad, W. I.: Tulane Studies Geology, v. 5, no. 3, p. 93–131, illus., tables, 1967.

Middle Tertiary calcareous nannoplankton in the Cipero section are described, and their distribution in samples from foraminiferal zones of Bolli shown. A zonation based on calcareous nannoplankton is indicated. Some correlations with strata elsewhere, using these zones, are suggested. Of the genera two are new: *Orthorhabdus* and *Orthozygus*. Of the 52 described species 16 are new: *Cyclococcolithus neogammation, Helicosphaera ampliaperta, H. compacta, H. obliqua, H. parallela, H. truncata, Staurolithites minutus, Discoaster adamanteus, D. extensus, D. tani ornatus* (n. subsp.), *Orthorhabdus serratus, Sphenolithus belemnos, S.*

ciperoensis, S. predistentus, S. pseudoradians, and *Triquetrorhabdulus rugosus.—from* Authors' abstract

04315 **Brauns, Josef; Leussink, Hans.** Large-scale testing of rockfill materials—Discussion [of paper 5128 by R. J. Marsal, 1967]: Am. Soc. Civil Engineers Proc., v. 93, paper 5545, Jour. Soil Mechanics and Found Div., no. SM6, p. 383–388, illus., 1967.

Particle breakage under stress was found by Marsal [ibid., v. 93, no. SM2, p. 27–43, 1967] to be the most important factor affecting shear strength and compressibility in triaxial tests on rockfill materials for the El Infernillo Dam in Mexico. In this connection, some results of the writers' theoretical and experimental investigations on danger of failure of individual grains in triaxial tests under high pressures are described. In particles of relatively cubic or spherical form, breakage occurs as soon as the maximum tensile stress in the grain—caused by the normal and tangential contact forces—reaches a critical value, because materials such as quartz and glass are brittle and fail in tension. Based on the theory of elastic contact, it is shown that the tangential component of the contact force causes considerably higher tensile stresses than the normal component.—VMJ

04413 **Breed, William J.** Arizona's oldest amphibian: Plateau, v. 40, no. 2, p. 68–71, illus., 1967.

A trackway found in Supai-type sediments [Pennsylvanian] of Stanton's Cave in Marble Canyon has been identified as those of *Batrachichnus (Exocampe?) delicatulus* (Lull 1918), a form previously described from the Hermit Shale (Permian). The occurrence of these oldest amphibian tracks of Arizona in the sediments of an ancient cavern is unique.—Author's abstract

04412 **Breternitz, David A.** The eruption(s) of Sunset Crater—Dating and effects: Plateau, v. 40, no. 2, p. 72–76, 1967.

[Efforts at dating Sunset Crater, Ariz., are reviewed.] T. L. Smiley (1958) has proposed the date of A.D. 1064–1065 for the eruption; in this paper the date of 1066–1067 is suggested. Although such a discussion may be purely pedantic, there is the possibility that both dates are correct and that there were actually at least two eruptions. Regardless of the exact chronology of the eruption, it is suggested that further investigations to determine the aboriginal cultural consequences and responses to the eruption might prove fruitful.—*from* Author's abstract

04591 **Briggs, Reginald P.** The Malo Breccia and Cotorra Tuff in the Cretaceous of central Puerto Rico, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1966: U.S. Geol. Survey Bull. 1254-A, p. A23–A29, illus., 1967.

04691 **Bright, Robert C.** Late Pleistocene stratigraphy in Thatcher Basin, southeastern Idaho: Tebiwa, v. 10, no. 1, p. 1–7, illus., 1967.

Thatcher basin lies in the Bear River valley between Chesterfield and Cleveland, Idaho. Peale's (1879) Gentile Valley Group is redefined, and three stratigraphic units are mapped and described. The lower, Main Canyon Formation in the southern part is composed of fossiliferous, light colored, almost horizontal, unconsolidated lacustrine sediments more than 600 feet thick. The Gem Valley volcanics, the next youngest unit, are flat lying basalt flows and associated basaltic cinder cones. The Niter Loess, the youngest unit, is an extensive brown, gray, or yellow windblown silt that mantles all the older rocks. Lake Thatcher spilled southward and, assisted by the inflow of the Gem Valley volcanics, diverted Bear River to the south.—HRC

Brindley, G. W. *See* Thompson, T. D. 04405

04628 **Broadhurst, Sam D.; Pallen, Eldon.** An introduction to the topography, geology, and mineral resources of North Carolina: North Carolina Div. Mineral Resources Educ. Ser. 2, 20 p., illus., tables, revised 1967; originally published 1952.

Sea terraces break the flat topography of the Coastal Plain into broad steps. The Piedmont extends 200 miles from the Coastal Plain to the Blue Ridge, which marks the eastern border of the mountain region, the Great Smoky Mts. being the western. A generalized geologic map and a time scale showing events in North Carolina are included. Cretaceous to Quaternary formations of the Plain produce marl, sand, and gravel for construction; shale from Piedmont Triassic belts is used for brick and tile; limestone is produced from Cambrian beds along the east mountain front; metallic minerals, few of commercial importance, are found in igneous and metamorphic rocks; there are important deposits of industrial minerals and construction materials; and a phosphate-bearing bed has been discovered underlying Beaufort County. In 1966, North Carolina led all states in production of feldspar, mica, and lithium.—ESL

Broecker, Wallace S. *See* Ku, Teh-Lung. 04329

04654 **Brookins, Douglas G.** The strontium geochemistry of carbonates in kimberlites and limestones from Riley County, Kansas: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 235-240, illus., table, 1967.

Kimberlites containing possible primary (carbonatitic) carbonates intrude Permian limestones and shales in Riley County, Kansas. Four types of carbonates have been investigated for their Sr isotope ratios and total Sr contents. The carbonate types recognized are: 1) post-emplacement veins: 2) local limestones: 3) pre-emplacement (possible primary carbonate) veins: and 4) replacement and interstitial carbonates. The average Sr-87/Sr-86 measurements are: 0.7086, 0.7081, 0.7038, and 0.7060. The average total Sr contents (in ppm) are: 304, 338, 4280, and 982. These data suggest derivation of post-emplacement veins from the local country rocks, a probable original carbonatitic source for the pre-emplacement veins, and a mixture of carbonatitic and sedimentary carbonates for the interstitial and replacement material.—Author's abstract

04394 **Brown, Harold A.** Structural control of the Canadian River in western Oklahoma: Shale Shaker, v. 18, no. 3, p. 42-50, illus., table, 1967.

The Canadian River and its tributaries have cut steep-sided V-shaped canyons in Permian and Pliocene strata with a very low southeast dip. Since the low dip reveals little about structure, stream patterns were studied. The upper river forms three anomalous U-shaped bends, underlain by an east-west trend which is the belt of maximum flexure; each bend is above a syncline. This part of the river has Kansan terraces, and is old enough to be structurally adjusted, while the lower part and tributaries are no older than Illinoian, and follow topography. The drainage basin narrows downstream. The course of the old stream is not known. Quartermaster Creek will capture the Canadian in the near geologic future. An anomaly in drainage patterns over the West Crane oil field is attributed to stream capture rather than structure. Cross sections and a structure map on the base of the Blaine anhydrite are included.—ESL

04859 **Brown, Hugh Auchincloss.** Cataclysms of the earth: New York, Twayne Publishers, 281 p., illus., tables, 1967.

The book contains three parts, the first, comprising over half the book, covers evidence of careenings of the globe; mechanics of the Great Deluge; and Man, the past, present, and future. The second part includes: Newton on gravitation, physical evidence refuting the universal mutual attraction of masses theory, growth of the theory of gravitation repulsion, dynamic electricity, static electricity, and research projects. Origin of Earth's materials, pre-historic forest floors, creation of the oceans, and a cosmic cycle in time comprise the third part.—ESL

Brownlow, A. D. *See* Champlin, J. B. F. 04727

Bryant, C. T. *See* Foxworthy, B. L. 04839

04755 **Burchett, R. R.; Fagerstrom, J. A.; Schrott, R. O.** Stratigraphy of the Rakes Creek-Oskaloosa Shale interval (Upper Pennsylvanian) in Nebraska and Iowa [abs.]: Nebraska Acad. Sci. Proc., 77th Ann. Mtg., p. 17, 1967.

04656 **Burnett, D. S.; Wasserburg, G. J.** Evidence for the formation of an iron meteorite at 3.8×10^9 years: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 137–147, illus., tables, 1967.

Rb–Sr isotopic analyses were made on silicate inclusions from Kodaikanal, a brecciated fine octahedrite. Twelve analyses of different mineral fractions and separate inclusions were made. The silicates in this iron meteorite are highly enriched in alkalis and show Sr–87/Sr–86 ratios ranging up to 8.8. The samples lie on a well defined isochron on the Sr–Rb evolution diagram and indicate an age of $3.8\pm0.1\times10^9$ yr and an initial Sr–87/Sr–86 ratio between 0.69 and 0.73. These data provide unambiguous evidence for the 'formation' of younger solid objects in the solar system in a process which demands extensive chemical differentiation. This is evidence for an intermediate history for some meteoritic objects of a different sort than has been previously observed.—Authors' abstract

04598 **Burns, R. G.; Fyfe, W. S.** Crystal-field theory and the geochemistry of transition elements, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 259–285, illus., tables, 1967.

Elements of the first transition series constitue about 40 percent of the Earth, and occur as major and trace constituents in minerals. The crystal-field theory, both cubic and noncubic fields, is discussed because it has become prominent in interpretation of transition-metal chemistry. The interatomic distances of transition-metal compounds are important also. Before the crystal-field theory can be widely used, absorption spectra of transition-metal ions must be studied in all media and conditions. Color and pleochroism are characteristic properties of minerals containing these ions. Thermodynamic properties of minerals are affected by crystal-field stabilization energies. Discussion of the distribution of transition elements in mineral-forming processes is divided into magmatic crystallization, and sedimentary and metamorphic processes. The ligand-field theory and polymorphic transitions are reviewed.—ESL

04705 **Butler, B. Robert.** More Haskett point finds from the type locality: Tebiwa, v. 10, no. 1, p. 25, illus., 1967.

Three additional examples of Haskett points from at or near the type site along the Snake River in Idaho are made of obsidian and obsidian tuff. One, about three quarters as large as all the other known ones, is illustrated.—HRC

Butterlin, J. *See* Bonet. F. 04720

Butterlin, J. *See* Bonet, F. 04825

04730 **Cabri, L. J.** A new copper–iron sulfide: Econ. Geology, v. 62, no. 7, p. 910–925, illus., tables, 1967.

The mineral, from Noril'sk, Siberia, has a composition close to $Cu_{18}(Fe,Ni)_{18}S_{32}$, and a large cubic cell with $a=10.64_8$A, possible space group I43m. The strongest X-ray powder diffraction lines are, in angstroms, 3.04, 2.656, 1.879, 1.598, 1.210, 1.079, and 1.0193. On heating, it breaks down to "tetragonal" cubanite and minor bornite; the original mineral is reformed on slow cooling. It is clearly a discrete mineral entity, not to be confused with the cubic high-temperature polymorph of chalcopyrite.—WSW

Cady, John G. *See* Daniels, Raymond B. 04344

Cady, John G. *See* Ruhe, Robert V. 04348

04683 **Cady, Wallace M.** Geosynclinal setting of the Appalachian Mountains in southeastern Quebec and northwestern New England, *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 57–68, illus., 1967.

The lower and middle Paleozoic orthogeosyncline of the northern Appalachians includes a broad eugeosynclinal zone, a miogeosynclinal zone to the northwest and southeast, and several geanticlines. Northwest of the orthogeosyncline is the

Precambrian craton. In the lowest Paleozoic rocks, the belt of transition between the northwestern miogeosynclinal zone and the eugeosynclinal zone lies northwest of the present Sutton–Green Mountain anticlinorium; the transition belt shifts southeastward in successively younger rocks. The geanticlines are recognized by stratigraphic convergence and unconformable overlap toward their axes. The orthogeosyncline and craton in Quebec are overlain by an Upper Ordovician exogeosyncline. Post–geosynclinal middle Paleozoic anticlinoria and synclinoria roughly coincide with the geosynclinal features.—*from* Author's abstract

04447 **Campbell, C. A.; Paul, E. A.; Rennie, D. A.; McCallum, K. J.** Factors affecting the accuracy of the carbon–dating method in soil humus studies: Soil Sci., v. 104, no. 2, p. 81–85, illus., table, 1967.

The precision of the commonly used humus fractionation techniques and of the mass spectrometric analysis of humus carbon does not seem to be a serious limitation to the application of the carbon–dating method for soil humus studies.—JWH

04642 **Canada Geological Survey.** Aeromagnetic map, Sheet 43 B/12, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3946, scale 1:63,360, 1967.

04643 **Canada Geological Survey.** Aeromagnetic map, Oxford House, Manitoba: Canada Geol. Survey Geophysics Paper 7294, scale 1:253,440, 1967.

04796 **Canada Geological Survey.** Aeromagnetic map, Cabano, Quebec: Canada Geol. Survey Geophysics Paper 4949, scale 1:63,360, 1967.

04797 **Canada Geological Survey.** Aeromagnetic map, Squatec, Quebec: Canada Geol. Survey Geophysics Paper 4950, scale 1:63,360, 1967.

04798 **Canada Geological Survey.** Aeromagnetic map, Lac des Baies, Quebec: Canada Geol. Survey Geophysics Paper 4951, scale 1:63,360, 1967.

04799 **Canada Geological Survey.** Aeromagnetic map, Lac Prime, Quebec: Canada Geol. Survey Geophysics Paper 4967, scale 1:63,360, 1967.

04800 **Canada Geological Survey.** Aeromagnetic Sainte–Blandine, Quebec: Canada Geol. Survey Geophysics Paper 4968, scale 1:63,360, 1967.

04801 **Canada Geological Survey.** Aeromagnetic map, Nassau Lake, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3911, scale 1:63,360, 1967.

04802 **Canada Geological Survey.** Aeromagnetic map, Constance Lake, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3912, scale 1:63,360, 1967.

04803 **Canada Geological Survey.** Aeromagnetic map, Limestone Rapids, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3913, scale 1:63,360, 1967.

04804 **Canada Geological Survey.** Aeromagnetic map, Mammamattawa, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3914, scale 1:63,360, 1967.

04805 **Canada Geological Survey.** Aeromagnetic map, Sheet 42 K/9, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3915, scale 1:63,360, 1967.

04806 **Canada Geological Survey.** Aeromagnetic map, Trilsbeck Lake, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3916, scale 1:63,360, 1967.

04807 **Canada Geological Survey.** Aeromagnetic map, Nest River, Districts of Kenora and Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3917, scale 1:63,360, 1967.

04808 **Canada Geological Survey.** Aeromagnetic map, Sheet 42 N/8, Districts of Kenora and Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3918, scale 1:63,360, 1967.

04809 **Canada Geological Survey.** Aeromagnetic map, Sheet 42 N/9, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3919, scale 1:63,360, 1967.

04810 **Canada Geological Survey.** Aeromagnetic map, Sheet 42 N/16, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3920, scale 1:63,360, 1967.

04811 **Canada Geological Survey.** Aeromagnetic map, Sheet 43 C/1, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3921, scale 1:63,360, 1967.

04812 **Canada Geological Survey.** Aeromagnetic map, Sheet 43 C/8, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3922, scale 1:63,360, 1967.

04813 **Canada Geological Survey.** Aeromagnetic map, Sheet 43 C/9, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3923, scale 1:63,360, 1967.

04814 **Canada Geological Survey.** Aeromagnetic map, Menneval, Quebec–New Brunswick (2d edition): Canada Geol. Survey Geophysics Paper 4001, scale 1:63,360, 1967; originally published 1965.

04815 **Canada Geological Survey.** Aeromagnetic map, States Brooks, Quebec–New Brunswick (2d edition): Canada Geol. Survey Geophysics Paper 4005, scale 1:63,360, 1967; originally published 1965.

04816 **Canada Geological Survey.** Aeromagnetic map, Grandmaison, Quebec–New Brunswick (2d edition): Canada Geol. Survey Geophysics Paper 4007, scale 1:63,360, 1967; originally published 1965.

04817 **Canada Geological Survey.** Aeromagnetic map, Wild Goose Lake, Quebec–New Brunswick (2d edition): Canada Geol. Survey Geophysics Paper 4008, scale 1:63,360, 1967; originally published 1965.

04818 **Canada Geological Survey.** Aeromagnetic map, Lac Baker, Quebec–New Brunswick (2d edition): Canada Geol. Survey Geophysics Paper 4009, scale 1:63,360, 1967; originally published 1965.

04819 **Canada Geological Survey.** Aeromagnetic map, Saint Honoré, Quebec: Canada Geol. Survey Geophysics Paper 4931, scale 1:63,360, 1967.

04563 **Cano, Octavio.** A solution to the matrix absorption problem in quantitative elemental X-ray fluorescence analysis [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 808B–809B, 1967.

04468 **Carlson, Marvin P.; Boucot, Arthur J.** Early Silurian brachiopods from the subsurface of southeastern Nebraska: Jour. Paleontology, v. 41, no. 5, p. 1121–1125, illus., 1967.

Brachiopods ranging in age from upper Llandovery to lower Wenlock were obtained from core material in three wells, permitting correlation with outcrops in other areas. Thicknesses exceeding 500 feet are present with a three-fold lithologic subdivision. It is suggested that either lower and middle Llandovery deposition was restricted, or widespread erosion occurred prior to upper Llandovery time. The thickening of C_6 and younger sediments may be related to the Silurian basin in Illinois.—Authors' abstract

04756 **Carlson, Marvin P.** Summary of the Devonian System in Nebraska [abs.]: Nebraska Acad. Sci. Proc., 77th Ann. Mtg., p. 17, 1967.

04878 **Carnahan, Veryle.** Minerals of Los Angeles County—Pt. 1, Catalina Island, Palos Verdes, and Soledad Basin: Los Angeles County Mus. Nat. History Quart., v. 6, no. 2, p. 26–30, illus., 1967.

From Catalina Island, Calif., talc, actinolite, serpentine, and talc pseudomorphs after tremolite were collected from old Indian quarries. Minerals from the abandoned Black Jack sulfide mine are sphalerite, barite, dolomite, arsenopyrite and fluorite and varieties of quartz. Sea cliffs of the Palos Verdes Hills, about 100 feet high, contain many minerals in beautifully crystallized specimens—barite, dolomite, and diatomite. Origin of the colemanite deposits in the Soledad basin is a matter of disagreement, but the boron probably originated in the associated volcanic rocks. Numerous borate minerals are found in unusual forms.—ESL

04736 **Carr, M. S.; Guild, P. W.; Wright, W. B.** (compilers). Iron in the United States, exclusive of Alaska and Hawaii: U.S. Geol. Survey Mineral Inv. Resource Map MR–51, scale 1:3,168,000, separate text, 1967.

Two general categories of symbols are used on the map to show iron-ore deposits and iron-bearing deposits of lesser or only potential value. There is no consensus among geologists on the exact origin of all deposits nor complete agreement on a genetic classification, but a generalized subdivision has been made based on shapes, habits, and mineralogy. The text contains information on sedimentary deposits, those with igneous affiliations, residual ores, and other deposits. Many deposits are numbered by State on the map and identified by number in the index which gives also the geographic coordinates and brief geologic descriptions. A comprehensive bibliography is included.—MCM

04480 **Carroll, Robert L.** A limnoscelid reptile from the Middle Pennsylvanian: Jour. Paleontology, v. 41, no. 5, p. 1256–1261, illus., 1967.

A new genus and species of limnoscelid captorhinomorph, *Limnostygis relictus*, is described from the Middle Pennsylvanian of Florence, Nova Scotia. This genus is represented, along with at least three other reptilian genera, in the stumps of upright lycopods in the Morien group of the Sydney coal field. This is the first member of this family to be described from the Carboniferous and confirms Romer's suggestion that the Permian genus *Limnoscelis* is a relict of a very ancient reptilian lineage.—Author's abstract

04603 **Carstea, Dumitru Dumitru.** Formation and stability of Al, Fe, and Mg interlayers in montmorillonite and vermiculite [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 427B–428B, 1967.

04698 **Carter, John Lyman.** Mississippian brachiopods from the Chappel Limestone of central Texas: Bulls. Am. Paleontology, v. 53, no. 238, p. 253–488, illus., tables, 1967.

The Chappel Limestone, late Kinderhookian and possibly early Osagian in age, crops out along all but the southern edge of the Llano Uplift. The fauna is well-preserved. A systematic description of brachiopods in thirty-three families is given, along with a reassessment of Girty's taxa and the inclusion of his names (given to juvenile forms) into adult-form names. Fifty-one genera and sixty-five species are present, with three genera, *Cyphotalosia, Amesopleura, and Crassumbo*, being new; twenty-five new species are proposed also. Wherein possible, simple statistical techniques are used to characterize growth patterns of individuals and populations. The Chappel Limestone is correlated with the upper Chouteau Group of the Mississippi Valley.—HRC

04309 **Casagrande, Leo.** Subsoils and foundation design in Richmond, Va.—Closure [to discussion of paper 4915, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5545, Jour. Soil Mechanics and Found Div., no. SM6, p. 375; errata to paper 4915, p. 375, 1967.

In a discussion of the original paper, S. G. Granger [ibid., v. 93, paper 5215, no. SM5, p. 109–126, 1967] describes plugging of drill rods and deformation of clay strata during exploratory drilling in the Richmond area, and suggests that expansion

of the clay may be due to pressure build-up from organic decomposition. Casagrande agrees that presence of gases caused by organic decomposition would enhance such expansion; however, expansion resulting from swelling of sensitive clays upon disturbance is generally much more pronounced than that caused by stress relief and gas inclusion. Hard sensitive clays may be completely remolded under the effect of thick-walled split-spoon samplers, most of the disturbance occurring ahead of the sampling shoe. One minor correction to the original paper is made in the errata.—VMJ

Cathcart, James B. *See* Sever, Charles W. 04414

04822 **Chamberlain, Barbara Blau.** Cape Cod: Nat. History, v. 76, no. 5, p. 24–33, illus., 1967.

Cape Cod Natl. Seashore, Mass., is an example of both geologic creation and destruction. The Cape was created by Pleistocene glaciers, the ocean side being a 30-mile moraine. Martha's Vineyard, Nantucket, and Long Island were built by the same lobes. Hollows were eroded across the Cape by excessive melting, and ponds mark sites of abandoned ice. During glacial recessions, the sea left layers of marine sands and clays. After recession, the sea began to cut into the Cape and beaches and spits were built. The average erosion rate is 3 1/2 feet a year, and in places the cliffs are 180 feet high. Other features are Herring River, which follows a glacial gorge almost across the Cape; Pilgrim Heights, where the Cape ended after glacial times; and the dunes at Provincetown. Plant and animal communities and human history are discussed briefly.—ESL

04727 **Champlin, J. B. F.; Thomas, R. D.; Brownlow, A. D.** Laboratory testing and evaluation of porous permeable rock for nuclear waste disposal: U.S. Bur. Mines Rept. Inv. 6926, 33 p., illus., tables, 1967.

Simulated nuclear production plant waste fluids were injected into samples of sedimentary rock. High-level acidic wastes generally increase permeability, in contrast to low-level aqueous wastes which generally reduce permeability. Shales and clays have higher cation-retention capacity than sandstones, but much less permeability. The sandstones satisfy the requirements for reservoir rock for the subsurface disposal of nuclear waste and the shales and clays would make excellent confining formations.—KFF

04596 **Chao, E. C. T.** Impact metamorphism, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 204–233, illus., tables, 1967.

One of the most effective methods of investigating the origin of a circular structure is to make a detailed study of the mineralogic and petrographic changes of the rock material in which it is located. Unique microstructures, selective phase transitions, formation of vitreous phases without evidence of viscous flow, the occurrences of high-pressure polymorphs, and evidence of extremely high temperatures are considered as criteria of hypervelocity meteorite impact. The increasing degree of impact metamorphism in sandstone around Meteor, Henbury, and Wabar Craters is described. The criteria follow closely the degree of shock transformation of quartz. Photomicrographs of a granite gneiss around Ries Crater show various degrees of impact metamorphism. Some characteristics of phase transition and mineral reactions are described and tabulated. Impact metamorphic features in meteorites and tektites are considered also.—ESL

04633 **Chao, G. Y.; Harris, D. C.; Hounslow, A. W.; Mandarino, J. A.; Perrault, G.** Minerals from the nepheline syenite, Mont St. Hilaire, Quebec: Canadian Mineralogist, v. 9, pt. 1, p. 109–123, illus., tables, 1967.

Eighty-seven mineral species have been identified from the veins, vugs, and inclusions in the nepheline syenite, Desourdy Quarry, Mont St. Hilaire, Quebec. Many of these are rare minerals, found only in a few similar occurrences in the world. Chemical, optical and crystallographic data on 10 unidentified minerals are also presented. An X-ray identification table is attached, giving six strongest diffraction lines and their intensities.—Authors' abstract

04849 **Chaudhuri, Sambhudas; Faure, Gunter.** Geochronology of the Keweenawan rocks, White Pine, Michigan: Econ. Geology, v. 62, no. 8, p. 1011–1033, illus., tables, 1967.

Rb–Sr whole-rock analyses of Keweenawan rocks give the following radiometric ages: rhyolite flows near top of Portage Lake Lava Series 1100±25 m.y.; intrusive rhyolite near base of lava series and rhyolite from Porcupine Mountains 1042±6 m.y.; intrusive quartz porphyry 978±40 m.y.; Nonesuch Shale 1075±50 m.y., which is regarded as a close upper limit. Leads extracted from copper sulfides at White Pine have J-type isotopic compositions.—WSW

04572 **Chayes, Felix.** On the graphical appraisal of the strength of associations in petrographic variation diagrams, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 322–339, illus., tables, 1967.

A transformation that will often reduce drastically the closure effect of the data array in diagram is described along with the reasoning on which it is based, and a few practical applications. Examples used are: quartz and microcline in the Bellingham, Minn., granite; microcline and plagioclase in the Milford, N. H., granite; FeO and SiO_2 and CaO and SiO_2 in basalts and andesites of the Taupo Series, New Zealand; and relations of MgO, CaO, and FeO with SiO_2 in the Crater Lake, Oreg., volcanic series. It is hoped that this section will stimulate further study, and the "remaining space" transformation may find other applications.—ESL

04627 **Cheney, Eric S.; Lange, Ian M.** Evidence for sulfurization and the origin of some Sudbury-type ores [with German abs.]: Mineralium Deposita, v. 2, no. 2, p. 80–94, tables, 1967.

There is a reputed lack of field evidence for formation of Sudbury-type ores by introduction of country rock sulfur into still hot intrusions. Lead isotopic composition implies some metals were derived from the eruptive; sulfur isotopic data differ from and do not exhibit a common pattern of isotopic enrichment with respect to sulfides within associated intrusions; evidently the sulfur was derived from country rocks. Ores exhibiting magmatic textures commonly occur within more siliceous dikes than the host intrusions. Inorganic reduction of sulfate, which occurs only above 600°C with resultant sulfurization of ferrous iron and traces of other metals, would make the rock more siliceous. Above 1100°C the silicate residue and newly formed sulfides would form immiscible magmas; therefore, ore magmas within and near mafic intrusives can be epigenetic. Processes by which sulfur is introduced into intrusions remain speculative.—*from* Authors' abstract

04316 **Chilingar, George V.; Rieke, Herman H., 3d; Gray, Donald H.** Electrokinetic stabilization of an illitic clay—Discussion [of paper 5235 by M. I. Esrig and J. P. Gemeinhardt, 1967]: Am. Soc. Civil Engineers Proc., v. 93, paper 5545, Jour. Soil Mechanics and Found Div., no. SM6, p. 391–393, 1967.

Chilingar, Rieke, and others, have found that electrochemical stabilization of weak clay soils is due largely to cementation, contrary to Esrig and Gemeinhardt's [ibid., v. 93, no. SM 3, p. 109–128, 1967] findings that no cementation occurred. During electrochemical treatment using iron and aluminum electrodes, various minerals such as gibbsite, calcite, and hematite were formed; electrical treatment in some cases destroyed the clays. D. H. Gray does not agree that hardening of clay has developed solely from ion exchange and variation in soil-moisture content. Hardening which Esrig and Gemeinhardt ascribe to ion exchange is almost directly proportional to increase in pH above 7; they do not seem to consider that precipitation of a metal hydroxide or oxide may be the cause of both plasticity increase and electrochemical hardening.—VMJ

04740 **Chopra, Anil K.** Hydrodynamic pressures on dams during earthquakes: Am. Soc. Civil Engineers Proc., v. 93, paper 5695, Jour. Eng. Mechanics Div., no. EM6, p. 205–223, illus., table, 1967.

The intensity, distribution, and frequency characteristics of hydrodynamic pressures acting on dams during earthquakes are discussed. A review of previous work emphasizes evaluation of common simplifying assumptions. An analysis is made

of the pressures, including compressibility of water, generated on a rigid gravity dam with a vertical upstream face. General expressions for the complete time history of pressures during arbitrary horizontal and vertical ground motions are derived. It is concluded that the concept of an added mass, moving with the dam, to represent hydrodynamic effects is not valid for earthquake-type excitations; also significant errors are introduced by ignoring compressibility of water. The standard design practice in considering additional water pressures on dams due to earthquakes is compared with theoretical responses.—*from* Author's abstract

Churkin, Michael, Jr. *See* Brabb, Earl E. 04303

04475 **Cisne, John L.** Two new Mississippian trilobites of the genus *Paladin*: Jour. Paleontology, v. 41, no. 5, p. 1267–1272, illus., table, 1967.

The group of species assigned to *Paladin* Weller, 1936 and *Kaskia* Weller, 1936 forms a graded series with no discontinuities of generic significance. *Paladin* is redefined, and *Kaskia* is considered to be its junior synonym. *Paladin osagensis* sp. n. is the earliest known North American representative of the genus. The features of this species indicate that *Paladin* is descended from an early species of *Griffithides* Portlock, 1843. Statistical analysis of a large collection of *P. rosei* n.sp. casts doubt on the significance of three figure ratios commonly used in studies of Carboniferous trilobites.—*from* Author's abstract

04793 **Clark, Howard Charles, Jr.** The remanent magnetization, cooling history, and paleomagnetic record of the Marys Peak sill, Oregon [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 955B, 1967.

04341 **Clark, R. S.; Rao, M. N.; Kuroda, P. K.** Fission and spallation xenon in meteorites: Jour. Geophys. Research, v. 72, no. 20, p. 5143–5148, illus., tables, 1967.

Xenon isotope abundance data from other investigations have been analyzed with the aid of an IBM 7040 computer to determine by a least-squares method the best values for the isotope ratios of the fission and spallation xenon. The isotope ratios of Murray were used as the trapped or primordial component. The values obtained were: fission component (normalized to Xe-136=1.00) Xe-131=0.38, Xe-132=1.05, and Xe-134=0.95; spallation or cosmogenic component (normalized to Xe 130=1.00) Xe-124=0.64, Xe-126=1.07, Xe-128=1.53, Xe-131=3.73, and Xe-132=0.62.—Authors' abstract

04653 **Clark, Thomas H.** (editor). Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, 99 p., illus., tables, 1967.

This symposium, with the exception of three papers, is restricted to areas of the Canadian Appalachians affected by the Taconic and Acadian orogenies and excludes those areas affected by late Paleozoic mountain building. The 11 papers are cited separately.—VMJ

04498 **Climax Molybdenum Company.** The Urad molybdenum mine: Western Miner, v. 40, no. 10, p. 56–59, illus., 1967.

Molybdenite is in fractured rock surrounding a volcanic plug. The orebody contains 12 million tons.—ARK

Cline, M. G. *See* Dijkerman, J. C. 04459

04399 **Cloud, Preston E., Jr.; McKelvey, V. E.** The environmental sciences and national goals, *in* Applied science and technological progress—A report to the Committee on Science and Astronautics, U.S. House of Representatives by the Natl. Acad. Sci.: Washington, U. S. Govt. Printing Office, p. 229–254, 1967.

Environmental sciences develop knowledge on all aspects of environment, including natural resources, representing a dynamic system in which man has become the dominant element. Problems are complex and impinge on the lives of all and transcend private spheres of interest, so that considerable research is carried out

by Government-supported institutions. Quality of Government operations ranges from outstanding to substandard. Factors responsible for achievements of outstanding laboratories should be identified and introduced more widely. The Federal Government has clear responsibility to contribute heavily to discovery, development, and use of scientific and engineering brainpower. More Federal aid is needed for institutional and program development, and new universities should be built where they can contribute to nucleation of urban centers and meet expanded needs for education.—ESL

04749 **Coats, R. R.** Economic significance of revised age relations of rocks in the Cornucopia mining district, Elko County, Nevada: U.S. Geol. Survey Circ. 549, 4 p., illus., 1967.

Recent geologic work in the Cornucopia mining district, a small silver-gold mining district in northwestern Elko County, Nev., has resulted in significant revision of the geological interpretation. Rocks formerly thought to be premineralization in age, but unmineralized, are now known to be postmineral extrusives, resting unconformably on the altered andesite in which the ore bodies are found. Extensions of the known productive veins may be expected at shallow depth beneath the younger volcanic rocks, and are separated from the mined part of the veins by postmineral high-angle faults that have brought the younger volcanic rocks into fault contact with the mineralized andesite. Some veins are apparently terminated against premineral faults.—Author's abstract

04431 **Coe, A. V. Robertson.** Pitchfork oil field, Park County, Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 10, p. 2115–2121, illus., 1967.

The Pitchfork field, about 45 miles southwest of Cody, Wyo., now produces over 100,000 bbl per month, primarily from the Pennsylvanian Tensleep Sandstone. The field is on a north-trending anticline, six miles long and one mile wide, breached to the Cretaceous Maury Shale, with about 2,000 feet of closure at the top of the Tensleep Sandstone. From discovery in 1930 to 1955 water cuts in existing wells increased rapidly. Re-evaluation of geologic data led to a second stage of development (1955–62) based on production from higher structural positions. Further study led to a third stage of development (1962–present) based on production from unflushed "pods" of oil on the flanks. To date, no wells drilled to the Tensleep Sandstone have been dry.—BHK

04589 **Cohee, George V.; West, Walter S.; Wilkie, Lorna C.** Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1966: U.S. Geol. Survey Bull. 1254-A, p. A1–A43, illus., tables, 1967.

The changes in stratigraphic nomenclature are grouped together in the categories of (1) new names adopted for offical use, (2) previously used named adopted for official use, (3) names revised, (4) changes in age designation, (5) names reinstated, and (6) names abandoned. The stratigraphic names involved in change are listed alphabetically under each category. The age of the unit, the area in which the name is employed, the title of the report, and the publication in which the change is described are given.—*from* Authors' introduction

04764 **Cohen, Theodore Jerome.** Explosion seismic studies of the mid-continent gravity high [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 938B, 1967.

04886 **Colingsworth, Roscoe F.; Hohn, Matthew H.; Collins, Gary B.** Postglacial physicochemical conditions of Vestaburg Bog, Montcalm County, Michigan, based on diatom analyses: Michigan Acad. Sci., Arts and Letters Papers 1966, v. 52, p. 19–30, illus., table, 1967.

Diatoms in two cores of bog sediments were analyzed to establish the successional pattern; 128 species were identified. None were observed below 13.7 m, and those at that depth were smaller than at more shallow depths. An average of 16 species per sample depth from 13.7 to 6.4 m was recorded, increasing to 35 species at 6.2 to 5.8 m, and to 49 in surface material. The percent frequency of the diatoms was tabulated by categories of the pH, saprobic, halobion, and current spectra. The bog was initially alkaline, low in organic matter, and with salt concentrations

at fresh-water levels. Eutrophication is indicated at two depths; the first, at 13.0 m, was temporary; the second began at 6.2 m and continued to the top. Diatoms in the surface material suggest a dystrophic condition.—ESL

04884 **Colinvaux, Paul A.** A long pollen record from St. Lawrence Island, Bering Sea (Alaska): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 3, no. 1, p. 29–48, illus., tables, 1967.

A core of lake sediments from St. Lawrence Island in the Bering Sea has been examined by means of pollen analysis as part of an investigation into the environmental history of Arctic Alaska. A three-zone pollen sequence is compared with the three pollen zones at Imuruk Lake which span the Wisconsin Glaciation and the Postglacial period. The St. Lawrence Island record is thought to go back at least until the Late Glacial period, though an absolute chronology by radiocarbon is only available to 6,000 years ago. The pollen suggests a cold arctic tundra on the land bridge, a conclusion which is in accordance with records from other sites adjacent to the Bering Sea. Sands of a marine transgression, thought to be of Sangamon Interglacial age contain pollen suggesting a tundra similar to that of modern times.—Author's abstract

04872 **Colless, Donald H.** The phylogenetic fallacy: Systematic Zoology, v. 16, no. 4, p. 289–295, 1967.

"Phylogenetic fallacy" is the term by which Colless refers to the view that, in reconstructing phylogenies, we can employ something more than observed attitude of specimens, plus some concept of overall resemblance and some concept of an attribute of a set of such specimens. Wilson's consistency test, the Hennig system, and Camin and Sokal's method are discussed. A fossil taxon must be treated like any other taxon; every time-section represented by a taxon will introduce a new dimension. Therefore Colless believes that *the* phylogenetic classification is a competent phenetic classification, based on all available data.—ESL

04724 **Collins, A. Gene; Zelinski, William P.; Pearson, Cynthia A.** Bromide and iodide in oilfield brines in some Tertiary and Cretaceous formations in Mississippi and Alabama: U.S. Bur. Mines Rept. Inv. 6959, 27 p., illus., tables, 1967.

The iodide and bromide content of 280 oilfield brines from the Eutaw, Wilcox, Eagle Ford, Tuscaloosa, and other formations showed wide variations, with iodide ranging from 2 mg/l to 65 mg/l, and bromide from 52 mg/l to 1,760 mg/l. Ratios of iodide to chloride range from 0.0001 to 0.0007, with mean of 0.0002, compared with 0.000003 for sea water. Ratios of bromide to chloride range from 0.0006 to 0.0096, with mean of 0.0065, compared with 0.003 for sea water. A correlation matrix shows high correlation of bromide to calcium (.886), bromide to magnesium (.715), and bromide to chloride (.639). Similar correlations for iodide were not found.—KFF

Collins, Gary B. *See* Colingsworth, Roscoe F. 04886

Collins, Lorence G. *See* Hagner, Arthur F. 04850

04754 **Colton, Roger B.; Noble, Donald C.** Geologic map of the Groom Mine SW quadrangle, Nye and Lincoln Counties, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-719, scale 1:24,000, 1967.

04620 **Coons, Richard L.** Precambrian basement geology and Paleozoic structure of the midcontinent gravity high [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 739B, 1967.

Cooper, Arthur W. *See* Hardin, James W. 04507

04485 **Copeland, M. J.** A new species of *Dithyrocaris* (Phyllocarida) from the Imo Formation, Upper Mississippian, of Arkansas: Jour. Paleontology, v. 41, no. 5, p. 1195–1196, illus., 1967.

Nodules containing phyllocarid remains occur in Upper Mississippian shale near Peyton Creek, Arkansas. They are associated with marine fossils of Late Mississippian age.—Author's abstract

04487 **Copeland, M. J.** An occurrence of *Caryocaris* (Crustacea, Phyllocarida) from the Canadian Arctic: Jour. Paleontology, v. 41, no. 5, p. 1193–1194, illus., 1967.

Specimens of *Caryocaris* from Cornwallis Island, District of Franklin are reported for the first time. They occur in a stratigraphic section containing Late Wenlockian graptolites.—Author's abstract

04470 **Copper, Paul.** Pedicle morphology in Devonian atrypid brachiopods: Jour. Paleontology, v. 41, no. 5, p. 1166–1175, illus., 1967.

Devonian atrypid brachiopods developed a number of diverse and unusual strictures to enclose the pedicle opening. Several of these are described in detail for the first time, and appear to have no direct homologues in other brachiopod groups. The normal, sub-hypothyridid, rhynchonellid-like pedicle opening is bordered anteriorly by two conjunct, hollow deltidial plates with rabbet, tongue-groove, angle or straight joints and a crenulated outer surface. Thick, umbo-crowding pedicle layers and incipient pedicle collar bases are taxonomically distinctive. Simple, unattached separate pedicle collars (in the Atrypidae) and complex deltidial plate fused collars (in the Palaferellidae) are sporadically developed structures in atrypid ontogeny and phylogeny.—Author's abstract

04482 **Copper, Paul.** Brachidial structures of some Devonian atrypid brachiopods: Jour. Paleontology, v. 41, no. 5, p. 1176–1183, illus., 1967.

In the Atrypidae and Palaferellidae: crura are attached to socket plates and not to inner socket ridges or complete hinge plates; there are no true 'inner' and 'outer' or discrete and connected hinge plates in atrypids; crural bases vary from round and bulky to long and straight, and some crural bases are confused with true crura; crura are commonly 'feathered' and may consist of very loosely connected calcite fibres; some atrypids appear to have vestigial crura or show loss of crura and jugal processes; jugal processes are always separated and terminate in thick bosses, spine growths and hook-like plates; and spiral cones do not vary greatly with radical changes in shell shape. It is suggested that loss or reduction of calcified crura and juga was advantageous in high-energy environments, and that jugal processes, instead of connecting spiralia, served instead to act as levering devices in spiralium movement.—*from* Author's abstract

Cox, Allan. *See* Dalrymple, G. B. 04666

04706 **Crabtree, Dan E.** Notes on experiments in flintknapping—[Pt.] 3, The flintknapper's raw materials: Tebiwa, v. 10, no. 1, p. 8–25, 1967.

A basic step in artifact manufacture is understanding the proper stone for tool-making and reconciling the relationships of technique to material. The types of materials and techniques are described. Various types of rocks are described, and their petrologic properties are discussed in relationship to their usefulness in making artifacts. Cryptocrystalline and non-crystalline varieties of silica are best, followed by crystalline silica and then igneous rocks. Siliceous sediments and metamorphic rocks are used only modestly.—HRC

04765 **Craig, Douglas Bennell.** Structure and petrology within Shuswap Metamorphic Complex, Revelstoke, British Columbia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 938B–939B, 1967.

04363 **Crippen, John R.** Change in quantity of dissolved solids transported by Sharon Creek near Palo Alto, California, after suburban development, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D256–D258, illus., table, 1967.

Data collected in a small basin in the coastal region of central California before and after suburban development within the basin indicate that the total load of

dissolved solids carried from the basin by streamflow increased tenfold after development. There was a slight increase in imported solutes because of the importation of irrigation water, but this was not great enough to explain the increased outflow load.—Author's abstract

04611 **Cross, Ralph Herbert.** Water surge forces on coastal structures [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 668B, 1967.

04621 **Crowley, Donald Joe.** Paleoecology of an algal carbonate bank complex in the Late Pennsylvanian Wyandotte Formation of eastern Kansas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 739B–740B, 1967.

04354 **Culbertson, James K.** Evidence of secondary circulation in an alluvial channel, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D214–D216, illus., 1967.

Evidence of secondary circulation, or helical flow, has been found in the Rio Grande conveyance channel near Bernardo, N. Mex. Sand trails, or ribbons of sand, were deposited on a layer of clay as a result of the effect of helical flow cells which are estimated to have formed at flow depths of 0.15 ft and 0.3 ft. If these features are preserved in sedimentary deposits, they should serve as a diagnostic clue to the hydraulic environment under which the deposits were formed.—Author's abstract

04677 **Cumming, L. M.** Platform and klippe tectonics of western Newfoundland—A review, *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 10–17, illus., 1967.

Parts of two contrasting tectono-stratigraphic regions dominate the geology of western Newfoundland. The Anticosti-Strait of Belle Isle Platform is characterized by relatively undeformed Lower Palaeozoic carbonate rocks, which rest upon Late Precambrian crystalline basement rocks. Superimposed on the margin of the platform rocks is a structurally more complex sequence of klippe rocks, which represents an Appalachian eugeosynclinal environment derived from central Newfoundland. Flat-lying Carboniferous sedimentary rocks overlap onto the margin of the platform on Port au Port Peninsula. To the south, Carboniferous sedimentary rocks are folded parallel to the margins of a northeast-trending trough.—Author's abstract

Curray, J. R. *See* Shepard, F. P. 04332

04665 **Currie, R. G.; Ellis, R. M.; Russell, R. D.; Jensen, O. G.** Addendum [to paper by O. G. Jensen and others, 1966]—Analysis of Canadian long shot data: Earth and Planetary Sci. Letters, v. 2, no. 1, p. 75, table, 1967.

Results reported by Jensen, Ellis, and Russell (ibid., v. 1, no. 4, p. 211–221, 1966) are reexamined in the light of the paper by Liebermann and others (Jour. Geophys. Research, v. 71, no. 18, p. 4333–4339, 1966). Surface waves are now recognized at 12 stations with amplitudes as low as 0.4 mm; tentative identification has been made at two other stations. Average surface-wave magnitude using the vertical component is 4.1, and the horizontal component is 4.2. Using the empirical relation (m) between unified and surface wave magnitudes $m = 5.1$ is obtained for the 14 stations compared to $m = 6.0$ calculated from P-waves at 25 Canadian stations.—VSN

04506 **Custer, Richard L. P.** Occurrence of limestones in the Durham Triassic Basin [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 176, 1967.

Custer, Richard L. P. *See* Hood, William C. 04508

04495 **Cutshall, Norman Hollis.** Chromium-51 in the Columbia River and adjaent Pacific Ocean [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 1040B, 1967.

Cuttitta, Frank. *See* May, Irving. 04571

04311 **Dagan, G.** A method of determining the permeability and effective porosity of unconfined anisotropic aquifers: Water Resources Research, v. 3, no. 4, p. 1059-1071, illus., table, 1967.

Equations of unsteady flow toward a partially penetrating well in an unconfined aquifer of finite thickness are solved by linearization. It is assumed that the aquifer is nondeformable and anisotropic, effective porosity at the water table is constant, pumping discharge is constant, and drawdowns are small. The vertical component of flow velocity is not neglected, so the solution is equally valid in the vicinity and at large distances from the pumping well; in the latter case, it coincides with the Theis solution. A method of matching the theoretical solution with drawdown measurements during pumping tests is outlined, by which horizontal and vertical hydraulic conductivities and effective porosity of the aquifer may be determined. The method is illustrated by analyzing data from pumping tests carried out in three anisotropic aquifers.—*from* Author's abstract

04824 **Dale, R. H.** Land use and its effect on the basal water supply, Pearl Harbor area, Oahu, Hawaii, 1931-65: U.S. Geol. Survey Hydrol. Inv. Atlas HA-267, 2 sheets, scale 1:62,500, text, 1967.

Between 1931 and 1965, about 5,000 acres of sugarcane land in the Pearl Harbor area was converted to other uses; this report documents concomitant changes in ground-water recharge and discharge, and chloride concentration of basal water; basal water consists of a fresh-water body, transition zone, and underlying sea water in the basaltic aquifer. Fresh water grades into sea water but a thick section of poorly permeable coastal plain deposits isolates basal water from the Pacific Ocean. Throughout the period, estimated average ground-water discharge was about 250 mgd, equivalent to 45 in. of recharge over the basaltic-aquifer outcrop area. Recharge is by direct infiltration of rain and of irrigation water. Changes in chloride concentration are related to geographic location, depth, and time. Heavy pumping by shafts caused an inland movement of saline water, and heavy pumping by wells an upward movement.—MCM

04666 **Dalrymple, G. B.; Cox, Allan; Doell, Richard R.; Grommé, C. S.** Pliocene geomagnetic polarity epochs: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 163-173, illus., tables, 1967.

A paleomagnetic and K-Ar dating study of 44 upper Miocene and Pliocene volcanic units from the western United States suggests that the frequency of reversals of the Earth's magnetic field during Pliocene time may have been comparable with that of the last 3.6 m.y. Although the data are too limited to permit the formal naming of any new polarity epochs or events, four polarity transitions have been identified: the W10 R/N boundary at 3.7±0.1 m.y., the A12 N/R boundary at 4.9±0.1 m.y., the W32 N/R boundary at 9.0±0.2 m.y., and the W36 R/N boundary at 10.8±0.3-1.0 m.y. The loss of absolute resolution of K-Ar dating in older rocks indicates that the use of well defined stratigraphic successions to identify and date polarity transitions will be important in the study of Pliocene and older reversals.—Authors' abstract

04766 **d'Anglejan-Chatillon, Bruno F.** The marine phosphorite deposit of Baja California, Mexico—Present environment and recent history [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 939B, 1967.

04343 **Daniels, Raymond B.** Soil landscapes in the thick loess of central Pottawattamie County, Iowa—Chap. 4 *in* Landscape evolution and soil formation in southwestern Iowa: U.S. Dept. Agriculture Tech. Bull. 1349, p. 205-231, illus., tables, 1967.

A small watershed was selected to determine the relation between a landscape, its evolution, and soil genesis. Wisconsin loess is the main parent material and has several zones whose sequence and properties are given in a measured section. Post-Tazewell erosion exposed the zones and left the Tazewell surface above the valley floor. Distribution of soils parallels outcrop of loess zones, and, within a zone, geomorphic surfaces, so landscape evolution influenced areal distribution. Weathering histories of Tazewell and Recent surfaces differ considerably. Tazewell Marshall soils started development more than 14,000 years ago under a forest,

replaced by grass about 6,800 years ago; they weathered under moist regimes producing the loess zones. The surface on which Monona and Dow soils formed is less than 6,800 years old, and they may have eroded slightly. Napier soils formed on alluvium and underwent slow accretion on the surface.—ESL

04344 **Daniels, Raymond B.; Cady, John G.** Soils of the South Turkey Creek area, Greenfield quadrangle, Adair County, Iowa—Chap. 3 *in* Landscape evolution and soil formation in southwestern Iowa: U.S. Dept. Agriculture Tech. Bull. 1349, p. 163–203, illus., tables, 1967.

The study area is in the Shelby–Sharpsburg–Winterset soil association area. Three paleosols are described—a buried Yarmouth–Sangamon, an exposed late Sangamon, and a truncated soil. Paleogeomorphic surfaces make mapping of paleosols difficult. Soils of the Tazewell uplands and the late Wisconsin–Recent complex on valley slopes in Kansan till, and in valley-side alluvium are described. Soils in the area formed in a variety of parent materials and under two geomorphic surfaces. It is concluded that the major period of erosion on valley slopes is late Wisconsin–Recent. Morphology of all soils is similar, but analyses show differences in depth of leaching, organic matter accumulation, and clay distribution. Weathering effects and soils history are reviewed.—ESL

04847 **Darnley, A. G.** Adapting gamma-ray spectrometer for purposes of aerial mapping: Northern Miner, v. 53, no. 36 (141), p. 70–71, 76, 1967.

The Geological Survey of Canada has made closely spaced spectrometric ground measurements over two test strips in Ontario, followed by airborne measurements. The object is to obtain a specification for a gamma-ray spectrometer system suitable for regional mapping of uranium, thorium, and potassium distribution. The nature of gamma radiation and potassium decay is discussed and types of spectrometers described. Gamma radiation from bedrock would be absorbed by 18 inches of overburden, but the bismuth–214 content of the soil may reflect variation in uranium content of bedrock. For the reconnaissance stage of uranium exploration, a high count rate is essential, and can be obtained best with a wide-spectrum survey, but such a survey will lead to many spurious anomalies which can be reduced by gamma-ray spectrometry.—ESL

04527 **Davidson, C. F.** The so-called "cognate xenoliths" of kimberlite, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 342–346, illus., 1967.

Evidence is summarized here to support the hypothesis that eclogite and garnet-peridotite xenoliths in kimberlite breccias are metamorphic rocks of crustal origin.—VSN

04529 **Dawson, J. B.** A review of the geology of kimberlite, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 241–251, illus., 1967.

Kimberlite, a serpentinized and carbonated mica peridotite of porphyritic texture containing nodules of ultrabasic rock-types characterized by certain high-pressure minerals, may or may not contain diamonds. It occurs in diatremes, dikes, veins, and sills, always in very small bodies. It occurs in vertically oriented volcanic pipes; several types are recognized as a result of position in the volcanic cycle. It ascends as a fluid or crystal mush slowly up a system of deep-seated tension fractures. Most are confined to the interior and margins of the shield on stable platforms of continental areas. Details of its petrography are described, as are individual occurrences throughout the world, including the United States.—HRC

04531 **Dawson, J. B.** Geochemistry and origin of kimberlite, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 269–278, illus., tables, 1967.

The major and minor elements in kimberlite are discussed in detail. Basaltic and micaceous kimberlites are distinct petrographically, and there is complete chemical gradation between them, and also from kimberlites to alnöites and carbonatites.

Kimberlites differ from other ultramafics chemically. They have a low Mg/Fe ratio, an unusually high K/Na and Fe^{3+}/Fe^{2+}; the fixed H_2O content averages 7.7 percent. They have high concentrations of ultrabasic minor element suites, and of carbonates. Features needing explanation in any hypothesis of origin are listed, and the evidence for the carbonatite–kimberlite relationship is reviewed. Kimberlite could be an end product of the interaction between a water-rich ankeritic fraction of a carbonatite magma and the granite crustal rocks.—HRC

04461 **DeBacker, L.; Klute, A.** Comparison of pressure and suction methods for soil-water content–pressure–head determinations: Soil Sci., v. 104, no. 1, p. 46–55, illus., 1967.

If soil samples used for the determination of water–content–pressure–head curve are initially at saturation and their packing remains the same during the determination procedure, the methods of Richards and of Haines are equivalent. In the case of initially unsaturated soil samples, the two methods give different results.—JWH

04387 **Decker, Robert W.; Peck, Dallas L.** Infrared radiation from Alae lava lake, Hawaii, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575–D, p. D169–D175, illus., table, 1967.

Radiation and contact temperatures of the surface of Alae lava lake, Hawaii, ranged from 15°C to 85°C during the day and night in November and December 1964, shortly after the lake solidified. Hottest temperatures were over fuming joint cracks, and the coolest temperatures were from nighttime measurements taken over the cooled thin margins of the lava lake. Surface–radiation heat loss from the central part of the lava lake is greatest at night, averaging 950×10^{-6} cal cm^{-2} sec^{-1} compared to the total calculated heat flow of approximately $4{,}300\times10^{-6}$ cal cm^{-2} sec^{-1}. During the day, solar radiation and other heat–transfer mechanisms mask any net surface–radiation heat loss from the cooling lava lake.—Authors' abstract

04757 **DeGraw, Harold M.** Areal differences in the thickness of the lower part of the transition zone at the top of the Pierre Shale in western Nebraska [abs.]: Nebraska Acad. Sci. Proc., 77th Ann. Mtg., p. 17–18, 1967.

04449 **Deist, J.; Talibudeen, O.** Rubidium–86 as a tracer for exchangeable potassium in soils: Soil Sci., v. 104, no. 2, p. 119–122, tables, 1967.

A method using Rb 86–labeled RbCl solution was tested to determine the amount Rb^+ adsorbed on cation–exchange sites on soils not accessible to K^+. The values obtained were closely related to the clay content of the soil. Rb:K exchange corrected for such fixed Rb gives values for exchangeable K very similar to K^+ exchangeable to N ammonium acetate.—JWH

Delavault, Robert E. *See* Warren, Harry V. 04821

04879 **Delevoryas, Theodore.** Mexican cycadeoid cones [abs.]: Am. Jour. Botany, v. 54, no. 5, pt. 2, p. 653, 1967.

04692 **Denevan, William M.** Livestock numbers in nineteenth–century New Mexico, and the problem of gullying in the southwest: Assoc. Am. Geographers Annals, v. 57, no. 4, p. 691–703, 1967.

In the 1880's, accelerated erosion produced large gullies throughout southwestern United States. This arroyo cutting was originally attributed to deterioration of the protective vegetation cover because of below normal rainfall and overgrazing. Recent studies have stressed the greater importance of increased high intensity rainfall. Additional perspective is provided by an examination of livestock numbers in the upper Rio Grande region of New Mexico during the 19th century, particularly during the Mexican period when, with little or no gullying, ranges were heavily stocked with sheep. The incomplete record of livestock numbers in relation to climate and gullying backs up the climatic argument and also gives some new support to the older view that overgrazing was a major contributive factor causing severe modern gullying.—*from* Author's abstract

04652 **Denny, Charles S.** Surficial geologic map of the Dannemora quadrangle and part of the Plattsburgh quadrangle, New York: U.S. Geol. Survey Geol. Quad. Map GQ-635, scale 1:62,500, section, 1967.

04622 **Desborough, George Albert.** Differentiation of Precambrian olivine diabase in southeastern Missouri [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 740B, 1967.

04459 **Dijkerman, J. C.; Cline, M. G.; Olson, G. W.** Properties and genesis of textural subsoil lamellae: Soil Sci., v. 104, no. 1, p. 7–16, illus., table, 1967.

Field and micromorphological observations indicate that many textural subsoil lamellae are the result of pedogenic processes. Some are sedimentary layers inherited from the original deposit. Others are formed by clay illuviation without relation to inherited sedimentary structures. Still others have illuvial clay superimposed upon inherited sedimentary structures. Any one or any combination of these three kinds of textural subsoil lamellae may be present.—JWH

Dill, Charles. *See* Kier, Jerry. 04512

04626 **Doe, Bruce R.; Tilling, Robert I.** The distribution of lead between coexisting K-feldspar and plagioclase: Am. Mineralogist, v. 52, nos. 5–6, p. 805–816, illus., tables, 1967.

The concentrations of lead in coexisting K-feldspar and plagioclase were determined by isotope dilution for plutonic, volcanic, and metamorphic rocks covering the geologic age range 25–2500 m.y. The most common value of the distribution ratio favors K-feldspar within 10 percent of a factor of 2.4 and no example was found where lead is enriched in plagioclase relative to K-feldspar. A single value of the distribution ratio could mean that the ratio is not a function of temperature, that all the feldspar pairs investigated formed at close to the same temperature, or that lead in minerals exchanges rapidly with their surroundings upon cooling to some minimum temperature.—*from* Authors' abstract

Doell, Richard R. *See* Dalrymple, G. B. 04666

04433 **Dollase, W. A.** The crystal structure at 220°C of orthorhombic high tridymite from the Steinbach meteorite: Acta Cryst., v. 23, pt. 4, p. 617–623, illus., tables, 1967.

Tridymite from the Steinbach meteorite has been examined at 220°C and found to be orthorhombic, space group $C222_1$ with $a=8.74$, $b=5.04$, $c=8.24$ A. The crystal structure has been determined and refined, using single-crystal counter-diffractometer data, to $R=8.6$ percent. The resulting structure, though similarly connected, is distorted in comparison with the ideal high-tridymite structure. The tetrahedra remain nearly regular but are rotated from the ideal positions. The oxygen atoms show strong disorder which is interpreted as thermal in origin. The magnitudes of the thermal displacements, especially of the oxygen atoms normal to their bonds with silicon atoms, are unusually large, amounting to 0.4 A. Author's abstract

04569 **Dolman, Jan Dirk.** Genesis, morphology, and classification of organic soils in the Tidewater region of North Carolina [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 764B–765B, 1967.

04877 **Donohue, Mildred D.; Gordon, Norma S.** (compilers and editors). Fossil finds in Maryland—A retrospective bibliography: College Park, Md., Univ. Maryland Libraries, 233 p., 1967.

This bibliography began as a project for joint use by the two reference rooms in the McKeldin Library at the University of Maryland. The bibliography section lists all source articles used and is arranged alphabetically by author. The index lists fossils (by genus and species), ages, and locations in one alphabet; under each item the pertinent authors, with dates of articles referred to, are arranged alphabetically. Every known mention of Maryland fossils, from the earliest (end

of 18th century) to the end of 1966, was examined. There is some overlapping geographically into neighboring states and the district of Columbia. Serial abbreviations and titles are listed.—MCM

04840 **Doonan, Charles J.; Hendrickson, Gerth E.** Ground water in Iron County, Michigan: Michigan Geol. Survey Water Inv. 7, 61 p., illus., tables, 1967.

The ground-water resources of Iron County are unevenly distributed but adequate for present needs. Wells yielding several hundred gallons per minute can be developed in glacial outwash areas along streams. On the other hand, in upland areas, a well yielding only a few gallons per minute may be difficult to develop. Most well water in the county is moderately hard to hard, and some areas contain objectionable amounts of iron. All public water supplies are obtained from ground water. Maps showing data-collection sites and glacial deposits are included.—Authors' abstract

04408 **Dort, Wakefield, Jr.** Late Cenozoic volcanism, St. Joe Valley, Idaho: Northwest Sci., v. 41, no. 4, p. 141–151, illus., 1967.

Northern Idaho has remnants of basaltic flows that appear to have come from a different source than the Columbia River flows extending up major valleys. One is in the valley of the St. Joe River, which flows from the Montana line to Coeur d'Alene Lake. In the lower third of the valley, there is a basalt flat at about 3,200 feet, 1,000 feet above the floodplain, and 400 feet higher than the Columbia River basalt flat. Peaks of Belt Series rocks protrude through the basalt, and the surface slopes to the west. It is concluded that the St. Joe Valley basalt flowed westward and met the eroded Columbia River basalt at Indian Mtn. Disparity in valley-floor widths of the Coeur d'Alene and St. Joe Rivers is a consequence of contrasting histories due to difference in age of the flows. It is estimated that the St. Joe Valley basalt was extruded in latest Pliocene or early Pleistocene time.—ESL

Doyle, H. A. *See* Hales, A. L. 04347

04511 **Doyle, Larry J.; Maynard, J. Barry.** Grain size distribution on the North Carolina shelf [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 179, 1967.

Dracup, John A. *See* Vemuri, Venkateswararao. 04312

04534 **Drever, H. I.; Johnston, R.** The ultrabasic facies in some sills and sheets, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 51–63, illus., table, 1967.

Only rarely do alkaline ultrabasic rocks form the major part of sills, whereas typical alkaline picrites do. Picrite-dolerite and picrite-teschenite do not form dikes. Features of alkaline picrite facies in dikes are outlined. The tholeiitic or quartz dolerite sills which contain ultrabasic facies are commonly associated with contemporaneous eruption of tholeiitic flood basalts. The facies is usually developed in sills and sheets and not as a facies of the dolerite dikes. Widespread picritic basalts of tholeiitic affinity are common, however. Features of these facies are listed and described. In both alkaline and tholeiitic ultrabasic facies, olivine, plagioclase, and augite are the principal minerals. Variations in texture and composition and petrogenesis are described.—HRC

04536 **Drever, H. I.; Johnston, R.** Picritic minor intrusions, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 71–82, illus., tables, 1967.

Picrites occasionally form small dikes, sills, or sheets, varying from a foot to more than 30 feet wide. Examples from West Greenland and elsewhere are described, and interest in possible natural magnesium-rich magmas is revived. The Greenland deposits cut zeolite-rich picritic lavas, and a few are lava flow feeders. Distinctive feldspathic banding occurs near the upper layers; details of the petrography and petrogenesis are given. They are due to differentiation, during emplacement, of a liquid in which olivine crystals of different sizes were carried in suspension. Tables show numerous chemical analyses and composition of olivine and plagioclase. The

chemical diversity is characterized by differences in the iron ratio unaccompanied by a change in the alkali/lime ratio.—HRC

04397 **Drew, Harvey L.** Fundamental geology of water bearing formations: Ground Water Age, v. 2, no. 4, p. 24–28, 1967.

Hydrology is the science relating to the Earth's water which can be divided into three parts: ground water, surface water, and water in the air. There are two major types of ground water, of which water occurring in pores or spaces in a rock or sediment is of most importance to drillers. Subsurface water reservoirs are found in igneous, sedimentary, and metamorphic rock formations, but gravel, sand, and sandstone form the best reservoirs. The other two types of rocks yield water only from cracks or joints.—ESL

04559 **Drew, Lawrence James.** Grid drilling exploration and its application to the search for petroleum [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 1038B–1039B, 1967.

04388 **Drewes, Harald.** A geochemical anomaly of base metals and silver in the southern Santa Rita Mountains, Santa Cruz County, Arizona, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575–D, p. D176–D182, illus., tables, 1967.

An area of Jurassic granite northwest of Patagonia, Ariz., altered in Paleocene (late Laramide) time, contains anomalous amounts of Cu, Pb, and Zn, and also contains sporadic anomalous concentrations of Au, Ag, and Mo. Background values of the three base metals are, respectively, about 15, 25, and 25 ppm. Samples in the altered area show concentrations of 2 to more than 100 times these background values, and over a substantial part of the area they are 5–16 times background values. The ore metals were introduced or mobilized during alteration; at the same time B, Sc, Ti, V, and Zr were concentrated in the altered rocks.—Author's abstract

04610 **Drugg, Warren Sowle.** Palynology of the upper Moreno Formation (Late Cretaceous–Paleocene), Escarpado Canyon, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 508B, 1967.

04714 **Duff, P. McLaren D.; Hallan, A.; Walton, E. K.** Developments in sedimentology—[V.] 10, Cyclic sedimentation: Amsterdam and New York, Elsevier Publishing Co., 280 p., illus., tables, 1967.

The subject of cyclic or rhythmic sedimentation is considered excluding those broad sequences spanning whole systems or longer intervals and also thin-bedded laminae that are of trivial or local significance. Within these limits cyclic sedimentation ranges from clastic, organic, or evaporitic varves often less than 1 mm thick, through sequences of intermediate size up to thicknesses of tens and hundreds of meters. The literature is reviewed and examples cited on a worldwide basis for relevant data on all significant hypotheses. The eleven chapters discuss cycles in fluvial and lacustrine regimes, transitional regimes, epicontinental marine environments, flysch, sedimentary cycles and faunal change, and general conclusions.—VSN

04411 **Duncan, J. M.; Seed, H. Bolton.** Strength variation along failure surfaces in clay—Errata [to paper 4956, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 4971, Jour. Soil Mechanics and Found. Div., no. SM6, p. 376–377, 1967.

Seven corrections to the original paper [ibid., v. 92, no. SM6, p. 81–104, 1966] are itemized. In the formula on p. 96, line 7, and on p. 104, app. 2, $\Delta\sigma_r$ should be changed to read $\Delta\sigma_1$, the subscript signifying lateral stress.—VMJ

04320 **Duncan, James M.; Seed, H. Bolton.** Anisotropy and stress reorientation in clay—Closure [to discussion of paper 4903, 1966]: Am. Soc. Civil Engineers Proc., v. 93, paper 5545, Jour. Soil Mechanics and Found Div., no. SM6, p. 366–367; errata to paper 4903, p. 367, 1967.

The authors agree with A. S. Saada, in his discussion [ibid., v. 93, paper 5215, no. SM 3, p. 169–171, 1967] of their original paper [ibid., v. 92, no. SM5, 1966],

that the effects of anisotropy and stress reorientation are highly complex, but do not agree that existing concepts of clay strength should not be applied to studies of anisotropy with respect to strength. They point out the advantages in continuing to use the concept of effective stress and the Mohr–Coulomb failure criterion, which Saada finds objectionable. In the errata, two corrections to formulas in the original paper are cited.—VMJ

Dunlop, Peter. *See* Lee, Kenneth L. 04321

04767 **Dutro, John Thomas, Jr.** Stratigraphy and paleontology of the Noatak and associated formations, Brooks Range, Alaska [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 939B, 1967.

04742 **Eagle, Henry C.** Effective use of upper Snake River water resources—Discussion [of paper 5147 by J. W. Frink and M. K. Fulcher, 1967]: Am. Soc. Civil Engineers Proc., v. 93, Jour. Irrigation and Drainage Div., no. IR4, p. 153–154, 1967.

Frink and Fulcher [ibid., v. 93, no. IR 1, p. 99–112, 1967] in their outline of requirements for further development of ground-water resources of the upper Snake River basin above King Hill, Idaho, have suggested two locations north of Snake River as being particularly favorable for artificial recharge of the aquifer. Eagle here suggests that more emphasis might be placed on studies for artificial recharge south of the river below American Falls, where the aquifer is less favorable but where critical ground-water conditions now exist or are likely to develop. Water will spill to waste past Milner if American Falls Dam is replaced at its present height; this waste could be reduced if part of the spill could be diverted into the aquifer south of the river.—VMJ

04395 **Eakin, Thomas E.; Hughes, Jerry L.; Moore, Donald O.** Water-resources appraisal of Steptoe Valley, White Pine and Elko Counties, Nevada: Nevada Dept. Conserv. and Nat. Resources Water Resources–Reconn. Ser. Rept. 42, 48 p., illus., tables, 1967.

Steptoe Valley has a drainage area of 1,975 sq mi, and slopes to the north with mountain ranges on both sides. Crests of the ranges are 3,000 to 4,000 feet above the valley axis. Most of the runoff from the mountains above 7,000 feet is from snowmelt in the spring months; additional runoff below this level in the alluvial apron and valley lowland is erratic. A large quantity of ground water is stored in the valley-fill reservoir, and additional is stored in consolidated rocks. Discharge from lowland springs is largely removed by evapotranspiration. Chemical quality of the water is generally good. The effect of pumping on the ground-water system is shown by hypothetical examples.—*from* Authors' summary

Ellis, R. M. *See* Currie, R. G. 04665

04425 **Ells, Garland D.** Michigan's Silurian oil and gas pools: Michigan Geol. Survey Rept. Inv. 2, 49 p., illus., tables, 1967.

Most Silurian pools found to date are around the southern edge of the Michigan basin. Many Devonian structures around the edge and in the interior are yet to be tested and may yield Silurian hydrocarbons. Reservoir rocks are porous dolomitized intervals and reefs. Oil and gas traps in the former are often localized on synchronous structures related to underlying reefs or small salt-cored anticlines. Silurian reefs and salt structures are reflected by structural closures in formations as young as Mississippian; these structures are discussed and figured. Silurian subsurface nomenclature used in oil and gas exploration differs from formal nomenclature established by outcrop studies. Correlations are based mainly on mechanical logs. Terminology is discussed and related to log cross sections and other illustrations. General pool or field data, production, gas analysis, and some reservoir data are presented.—*from* Author's abstract

04423 **Elston, Wolfgang E.** Summary of the mineral resources of Bernalillo, Sandoval, and Santa Fe Counties, New Mexico (exclusive of oil and gas): New Mexico Bur. Mines and Mineral Resources Bull. 81, 81 p., illus., tables, 1967.

A brief history of mining in the State is given, and metal-producing districts are described in the three counties. Production at the Cerillos, Old Placer, and New Placer districts, in a belt of early Tertiary monzonite stocks and laccoliths, has totalled about 11 million dollars. The Nacimiento red-bed copper deposits and Cochiti district gold-silver veins have each yielded more than one million dollars. Annual production of nonmetals (pumice, scoria, shale, gypsum, and cement materials) ranges from 9 to 13 million dollars. Near Cerillos, 7 million tons of coking bituminous coal and anthracite have been mined; bituminous and subbituminous coal occurs in the Colorado Plateau and intermontane basins. Reserves of all coal are estimated at 5 billion tons.—ESL

Emerson, David E. *See* Stroud, Lowell. 04722

04333 **Emery, K. O.** Some stages in the development of knowledge of the Atlantic coast of the United States, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 307–322, illus., 1967.

Man knew parts of the Atlantic coast of the U.S. at least as long ago as 11,000 years, but not until the beginning of the sixteenth century was he able to express the shape of major sections of the shoreline in map form. Startling new techniques developed recently have especial value for many kinds of shoreline studies. These techniques include aerial radar, televised images from satellites, and photographs from satellites. During the period that man has inhabited and studied the shore zone, the shoreline has moved more or less progressively inland in response to a general rise of sea level amounting to about 123 m in 19,000 years. Further melting of glacial ice should produce further rise of level, leading eventually to a sea level about 60 m higher than at present and requiring a continual resettlement of man's habitations in the shore area.—Author's abstract

04325 **Emiliani, Cesare.** The Pleistocene record of the Atlantic and Pacific oceanic sediments; correlations with the Alaskan stages by absolute dating; and the age of the last reversal of the geomagnetic field, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 219–224, illus., 1967.

Curves obtained by O–18/O–16 analysis of two Caribbean cores of an undisturbed stratigraphic section to about 425,000 yr B.P. were used to reconstruct an average stratigraphic column and generalized temperature curve for the Caribbean–equatorial Atlantic region. Stratigraphically continuous cores from the eastern equatorial Pacific were correlated by temperature-dependent and -independent parameters; carbonate cycles are considered related to the succession of Pleistocene stages. Two cores penetrate sediments bearing a species of radiolarian *Pterocanium* which became extinct with the last reversal of the Earth's magnetic field, between 680,000 and 1,000,000 years ago by K–Ar dating. Th–230/U–238 dated interglacial deposits in Alaska correlate with temperature maxima of oceanic warm stages. C–14 and K–Ar datings of various glacial deposits correlate with oceanic cold stages.—VMJ

04650 **Emiliani, Cesare.** Stratigraphic correlations and the Pleistocene epoch, *in* Time and stratigraphy in the evolution of man—NAS–NRC, Div. Earth Sci., Symposium, Washington, D. C., 1965: Natl. Acad. Sci.–Natl. Research Council Pub. 1469, p. 56–62, table, 1967.

Because of the increased number of major temperature oscillations now known to have occurred during the Pleistocene, it is difficult to correlate oceanic and continental stratigraphies, as well as different continental stratigraphies, except by absolute dating. Moreover, because of the high frequency of Pleistocene temperature oscillations, it is impossible to correlate any two given continental stages in different sections unless both are dated by absolute methods with analytical and field errors smaller than one half the wave length of the oscillations (less than 20,000 years). Few dates thus far published for material older than about 60,000 years seem to meet this requirement.—MST

England, J. L. *See* Bell, P. M. 04580

04586 **Epstein, Samuel; Taylor, Hugh P., Jr.** Variation of O^{18}/O^{16} in minerals and rocks, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 29–62, illus., tables, 1967.

The oxygen isotope compositions of rocks and minerals are dependent on their genesis and history. The O-18/O-16 ratio of each igneous mineral is generally constant, so that the ratio of a rock reflects the proportion of the minerals composing it. Deviations from this usually reflect a specific process such as fractional crystallization. The O-18/O-16 ratio of metamorphic rocks and minerals may reflect the grade of metamorphism, and may be used as a geothermometer. Oxygen isotope data on sedimentary silicate rocks are few, and further study should help answer questions as to genesis. The Δ values of different mineral pairs give good indications of the temperatures of final equilibrium for a variety of rock types, and further calibrations and measurements should establish the isotope method of measuring temperatures.—*from* Authors' summary

04576 **Eugster, Hans P.; Skippen, George B.** Igneous and metamorphic reactions involving gas equilibria, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 492–520, illus., tables, 1967.

Experimental procedures making it possible to study reactions with gases involving up to four components have been tested for gases of the system C–O–H. Dehydration–decarbonization–redox reactions can now be investigated, and the method can be extended to many other gas systems. Usefulness of the equilibrium constant in relating experimental determinations to field data is emphasized and steps are outlined. Using this approach, it will be possible eventually to evaluate the chemical potentials of all those compounds whose magnitude is defined by the mineral assemblage as it appears today.—ESL

04612 **Eusufzai, Hossain Sekandar H. Khan.** Post glacial deposits as foundation media in lower alluvial valleys and deltaic areas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 668B, 1967.

04377 **Evenden, G. I.; Frischknecht, F. C.; Meuschke, J. L.** Digital recording and processing of airborne geophysical data, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D79–D84, illus., 1967.

The U.S. Geological Survey operates a geophysical research aircraft equipped with a magnetometer, gamma-ray spectrometer, input electromagnetic system, and a flightpath recovery system that includes a Doppler navigation system. The outputs from all these systems are digitized at a rate of 10 observations per second and are recorded on magnetic tape. Computer programs have been written to compute the flight path of the aircraft, to prepare profiles, to locate intersections of transverse and base lines, and to make drift corrections. The final program for aeromagnetic data yields a plot of the flight path, intersections of the desired magnetic contours with the flight path, and maximums and minimums along the flight path.—Authors' abstract

Fagerstrom, J. A. *See* Burchett, R. R. 04755

04406 **Faruqi, F. A.; Okuda, Susumu; Williamson, W. O.** Chemisorption of methylene blue by kaolinite: Clay Minerals, v. 7, no. 1, p. 19–31, illus., tables, 1967.

The chemisorption of methylene blue by kaolinite crystals increased as the aqueous suspensions changed from acid to alkaline because, at high pH values, not only the basal pinacoids but the edge-faces were negatively charged. The inability to calculate acceptable specific surfaces or cation exchange capacities from the chemisorption data is discussed, with special reference to the orientation of adsorbed dye cations, the covering of more than one exchange site by a monomer or polymer, the different concentrations of exchange sites on the basal pinacoids and edge-faces respectively, the possibility that such sites occur on the tetrahedral rather than on the octahedral basal pinacoid, and the incomplete replacement of inorganic cations.—Authors' abstract

Faure, Gunter. *See* Chaudhuri, Sambhudas. 04849

04491 **Fields, Robert W.; Petkewich, Richard M.** Tertiary stratigraphy and geologic history of the upper Jefferson, Ruby, lower Beaverhead and lower Big Hole River valleys, *in* Centennial Basin of southwest Montana—Montana Geol. Soc., 18th Ann. Field Conf. 1967, Guidebook: [Billings, Mont.] Montana Geol. Soc., p. 71–78, illus., 1967.

The sedimentary basins in southwestern Montana are the result of Laramide faulting; sedimentation began in the late Eocene. The Bozeman Group is late Eocene(?), early and middle Oligocene, late Miocene, and early and middle Pliocene. The Lower Bozeman Group (the Passamari Formation in places) is predominantly fine-grained, more than 1,000 feet thick, and is Eocene and Oligocene in age. They are primarily drab-colored tuffaceous sandstones and siltstones with associated lenses of sandstones and conglomerates; the whole is generally fluvial and lacustrine. The Upper Bozeman Group are Miocene and Pliocene and are unconformable on the lower beds; they are typically more coarse and contain much ash. Post Pliocene movement has tilted the beds.—HRC

04469 **Finks, Robert M.** The structure of *Saccospongia laxata* Bassler (Ordovician) and the phylogeny of the Demospongia: Jour. Paleontology, v. 41, no. 5, p. 1137–1149, illus., 1967.

The demosponge, *Saccospongia laxata* Bassler, from the Ordovician (Trentonian) of Tennessee, is redescribed. It has a spiculation of styles arranged in plumose fashion in spicule tracts that form a reticulate net. Further, each tract is coated with a layer of tangentially arranged heloclonid desmas. This structure has some parallels in living desmacidontids. The complexity of its structure is unparalleled in any other Ordovician demosponge. Since all known pre-Carboniferous demosponges have only monaxon spicules, it is suggested that the primitive spicules of the Class Demospongea were monaxonic and that tetraxons arose subsequently in certain lines.—*from* Author's abstract

04876 **Fischer, Alfred G.; Honjo, Susumu; Garrison, Robert E.** Electron micrographs of limestones and their nannofossils: Princeton, N. J., Princeton Univ. Press, 141 p., illus., 1967.

A survey was made of fine-grained limestones to learn something of their fabric, and to gain new insight into different kinds of limestones and the processes forming them. The 85 micrographs reproduced are a sampling of hundreds of pictures of limestones ranging in age from Cambrian to Recent; 46 are Mesozoic, 26 Cenozoic, and the remainder Paleozoic. The 40 pages of text cover: techniques, positive and negative images, and interpretation; mineral grains and fabrics, mostly calcite; and fossils, mostly Coccolithophorida.—ESL

04365 **Fischer, Hugo B.** Transverse mixing in a sand-bed channel, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D267–D272, illus., table, 1967.

Rhodamine dye tracer was used to measure the transverse mixing coefficient in a large open channel. The flow was in a channel two feet deep and approximately 60 feet wide over a bed of sand dunes approximately 1-ft high. In one experiment the dye was injected on the channel centerline, and in another it was injected near the side. Both experiments yielded the same transverse mixing coefficient, $E_z = 0.11$ sq ft/sec. Normalized by the depth and shear velocity, the dimensionless coefficient was $E_z/dU^* = 0.24$, which is in excellent agreement with previous studies at laboratory scale.—Author's abstract

04695 **Fischer, William W.** Capabilities of remote sensors in collecting earth science information [abs.]: Assoc. Am. Geographers Annals, v. 57, no. 4, p. 787–788, 1967.

04725 **Fish, George E., Jr.** Clinton hematitic sandstone deposits, Butt Mountain area, Giles County, Va., *with a section on* Beneficiation evaluation by W. E. Lamont, C. E. Spruiell, Jr., and I. L. Feld: U.S. Bur. Mines Rept. Inv. 6966, 39 p., illus., tables, 1967.

The hematitic sandstones of the Clinton (Rose Hill) Formation crop out on Butt Mountain between the underlying Tuscarora Sandstone and the overlying Keefer Sandstone. Wide outcrop areas are present due to the prevailing low relief and shallow dip of the strata. The Clinton is 150–200 feet thick, and is composed of alternating shale, sandstone, and hematitic sandstone. Diamond drilling within an area 2 miles long by 3/4 mile wide revealed three hematitic beds within the Clinton. The thickest and most persistent as well as the highest grade of the three averaged 24 feet in thickness and 18.9 percent iron. Beneficiation studies reveal that medium grade iron concentrates could be produced but that the product is high in phosphorous and would require agglomeration.—KFF

Fitzsimmons, J. Paul. *See* Read, Charles B. 04631

04711 **Folk, Robert L.** Carbonate sediments of Isla Mujeres, Quintana Roo, Mexico, and vicinity, *in* Yucatán field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7: New Orleans, La., New Orleans Geol. Soc., p. 100–123, illus., revised 1967; originally published 1962.

04517 **Forbes, Robert B.; Kuno, Hisashi.** Peridotite inclusions and basaltic host rocks, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 328–337, illus., 1967.

A review of world-wide occurrences is given. Inclusions are, in decreasing abundance: gabbro, peridotite, basic granulites, garnet peridotite, and eclogite. The peridotite rocks occur on intraoceanic island archipelagos in the Atlantic, Pacific, and Indian Oceans, and on islands in the Bering, Japan, and China Seas, whereas garnet- and eclogite-bearing rocks are continental, mediterranean, and intraoceanic. Peridotite inclusion bearing basalts are in alkali basalt provinces. Tholeiitic basalts (eclogite or granulite-bearing) are in orogenic belts from andesitic volcanoes. Inclusion-bearing basalts are dominantly Cenozoic. The importance of the petrology of the host rocks is emphasized.—HRC

04751 **Foster, Helen; Karlstrom, Thor N. V.** Ground breakage and associated effects in the Cook Inlet area, Alaska, resulting from the March 27, 1964, earthquake: U.S. Geol. Survey Prof. Paper 543-F, p. F1–F28, illus., 1967.

Ground breakage in Cook Inlet area from the 1964 earthquake occurred largely in thick deposits of unconsolidated sediments; most important types were: fracturing or cracking and extrusion of sand and gravel with ground water along fractures, and slumping and lateral extension of unconfined faces. The principal breakage was concentrated in a northeast-trending zone about 60 miles long in the northern Kenai Lowland that cuts across diverse topography and stratigraphy; cracks were as much as 30 feet across and 25 feet deep. The outwash deltas of lakes and of the Susitna River showed much slumping; parts of flood plains of rivers were extensively cracked. A few avalanches and slumps occurred along the coast of Cook Inlet and some tidal flats were cracked. Changes in sea level, although caused partly by compaction of unconsolidated sediments, may largely be attributed to crustal deformation accompanying the earthquake.—*from* Authors' abstract

04380 **Foster, Robert L.** Tectonic inclusions from a serpentinite, east-central Alaska, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D120–D122, illus., 1967.

Mapping in the western Yukon-Tanana Upland has revealed the presence of northeast-trending alpine-type serpentinite masses with associated tectonic inclusions in the general vicinity of Livengood, Alaska. Serpentinite-associated tectonic inclusions have not been documented previously in Alaska.—Author's abstract

04441 **Fowles, Richard.** Dynamic compression of quartz: Jour. Geophys. Research, v. 72, no. 22, p. 5729–5742, illus., tables, 1967.

Measurements of the stress-density states achieved during shock compression of X-, Y-, and Z-cut crystalline quartz are presented. For the elastic shocks comparison is made with predictions based on acoustic measurements of the second-

and third-order elastic coefficients, and observed differences, which are substantial, are used to calculate two of the fourth-order coefficients. The values of c_{1111} and c_{3333} are found to be 159.3±20 percent×10^{12} and 184.9±20 percent×10^{12} dynes/cm^2, respectively. This procedure, employing the difference between acoustic measurements and shock wave measurements to evaluate higher-order elastic coefficients, should be generally applicable to solids that sustain large-amplitude elastic waves.—Author's abstract

04839 **Foxworthy, B. L.; Bryant, C. T.** Artificial recharge through a well tapping basalt aquifers at The Dalles, Oregon: U.S. Geol. Survey Water-Supply Paper 1594-E, p. E1-E55, illus., tables, 1967.

Increase in pumpage from wells tapping permeable basalt aquifers has caused serious declines in ground-water levels in The Dalles area. In a series of artificial-recharge tests, 81.4 million gallons of surplus water from Mill Creek was injected under pressure into a municipal well during four periods at an average injection rate of about 1,500 gpm. Specific capacity of the well was reduced temporarily. The artificial recharge had no seriously deleterious effects on ground-water quality. Injected water spread widely and rapidly through the highly permeable aquifers, amount of artesian pressure built up during injection periods dissipated rapidly, and no residual buildup of levels was measurable. Geologic and hydrologic conditions preclude escape of substantial amounts of recharge water from the ground-water subbasin. Although considered technically feasible, a long-term program will require modifications.—*from* Authors' abstract

04768 **Franks, Paul C.** Petrology and stratigraphy of the Kiowa and Dakota Formations (basal Cretaceous), north-central Kansas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 940B, 1967.

04516 **Franz, G. W.; Wyllie, P. J.** Experimental studies in the system CaO-MgO-SiO_2-CO_2-H_2O, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 323-326, illus., 1967.

Experiments in the system show that carbonatite could come from "a highly fluid liquid". A "synthetic magma" of the system can precipitate calcite, monticellite, forsterite, brucite, and portlandite at temperatures near 600°C. Low temperature carbonatitic liquid can coexist in stable equilibrium with "high temperature" magnesian silicate minerals, and support for the existence of genetic links between kimberlites and carbonatites occurs.—HRC

04614 **Fraser, Douglas Culton.** Rotary field electromagnetic prospecting [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 717B-718B, 1967.

04594 **Fredriksson, Kurt; Reid, Arch M.** Meteorite investigations by electron microprobe techniques, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 143-169, illus., tables, 1967.

The methods discussed are not solely applicable to the analysis of meteorites, but can be of value in other problems; however, they have greatly increased the available information on meteorite mineralogy. The electron microprobe and its use in qualitative and quantitative analysis are described. Its application to meteorites includes phase analysis; a histogram and photomicrographs are given. Special applications include: grain-size too small to allow analysis, bulk analyses of separated chondrules, minor-element analysis, and study of effects of thermal metamorphism.—ESL

Fredriksson, Kurt. *See* Reid, Arch M. 04595

Frink, John W. *See* Glover, Robert E. 04741

Frischknecht, F. C. *See* Evenden, G. I. 04377

Frost, John E. *See* Radtke, Arthur S. 04381

04671 **Funk, H.; Rowe, M. W.** Spallation yield of xenon from 730 MeV proton irradiation of barium: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 215–219, illus., tables, 1967.

The isotopic composition of xenon produced by 730 MeV proton bombardment of $BaCl_2$ was measured to be: Xe-124: Xe-126: Xe-127: Xe-128: Xe-129: Xe-130: Xe-131: Xe-132: Xe-134 corresponding to 72 : 100 : 102 : 116 : 111 : 72 : 183 : 52 : 4.6 respectively. The cross section observed for Xe-126 production was 0.140 barn. The agreement between these measured yields and the yields calculated by means of the spallation systematics of Rudstam is in general quite good; striking discrepancies occur, however, at Xe-130 and Xe-132. These findings confirm the relative yield found from meteoritic spallation xenon which shows similar discrepancies at Xe-130 and Xe-132. The discrepancy at Xe-129 between the meteoritic data reported by Rowe and spallation systematics is not confirmed in this work.—Authors' abstract

04668 **Funkhouser, J.; Kirsten, T.; Schaeffer, O. A.** Light and heavy rare gases in four fragments of the St. Severin meteorite: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 185–190, illus., tables, 1967.

Light and heavy rare gases were analyzed in four of the five recovered fragments of the St. Severin meteorite and in separated iron-enriched fractions. St. Severin is a typical amphoterite with respect to rare gas content. Variations in the absolute amount of rare gas isotopes (radiogenic, cosmogenic and Xe-129 excess) indicate a very heterogeneous mineralogical composition. The exposure age is 11 m.y.: the potassium-argon age is 4.4 b.y. (1028 ppm K), and the uranium-helium age is estimated to be 4.2 b.y. A small amount of primordial rare gas is evident in both silicate and iron phases.—Authors' abstract

04690 **Furer, Lloyd Carroll.** Sedimentary petrology and regional stratigraphy of the non-marine Upper Jurassic-Lower Cretaceous rocks of western Wyoming and southeastern Idaho [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 741B, 1967.

Fyfe, W. S. *See* Burns, R. G. 04598

04581 **Garrels, Robert M.** Genesis of some ground waters from igneous rocks, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 405–420, illus., 1967.

Enough data on the chemical behavior of minerals in low-temperature aqueous solutions are accumulating to make rough predictions about the behavior to be expected from simpler rock-water systems. Some types of interpretations that can be made from chemical analyses of actual waters are shown; ground waters from feldspathic igneous rocks are used as a related group of waters for illustration. Bar graphs are included. Correlation of plagioclase composition with water composition and alteration products are discussed.—ESL

Garrison, Robert E. *See* Fischer, Alfred G. 04876

04715 **Garside, Larry J.; Schilling, John H.** Wells drilled for oil and gas in Nevada: Nevada Bur. Mines Map 34, scale 1:1,000,000, 1967.

04843 **Geissman, T. A.; Sim, K.Y.; Murdoch, J.** Organic minerals—Picene and chrysene as constituents of the mineral curtisite (idrialite) [with German abs.]: Experientia, v. 23, no. 10, p. 793–794, 1967.

The isolation of picene and chrysene from a specimen of curtisite from Skaggs Springs, Calif., is reported, along with evidence that methyl homologs of these are present also.—ESL

Geldart, L. P. *See* Jones, F. W. 04664

Geldart, L. P. *See* Jones, F. W. 04667

Georgia Dept. Mines. *See* Georgia Institute Technology. 04392

Georgia Dept. Mines. *See* Georgia Institute of Technology. 04437

04437 **Georgia Institute of Technology; Georgia Dept. Mines.** South Georgia Minerals Program, Proj. Rept. 5: Atlanta, Ga., Georgia Dept. Mines, Mining and Geology, 74 p., illus., tables, 1967.

The first part of this report presents data from core-drilling in six counties. Phosphorite layers from western Atkinson County and central Berrien County are similar to those in northern Lanier, but occur at greater depth. It appears that higher BPL (bone phosphate of lime) content matrices extend northward from western Lanier County in a broad band, closer to the surface. Electric and gamma-ray logs for each county are included. The second part of the report presents certain data not included in prior reports; and the third, calculated economic factors and unique figures of merit; these two parts are appendices.—ESL

04392 **Georgia Institute Technology; Georgia Dept. Mines.** South Georgia Minerals Program—Proj. Rept. 6, Effingham County, sands and heavy minerals, phosphate-sand: Atlanta, Ga., Georgia Dept. Mines, Mining and Geology, 113 p., illus., tables, 1967.

Since old beaches had been reported in the county, the emphasis in core drilling was more on sands and heavy minerals, although phosphorites were studied also. Data from other counties drilled, but not reported, are included to complete the sands picture. Phosphates were not of economic value. There are definite commercial potentials in the sands in Effingham and in a group of five counties in the south-central part. Heavy minerals did not occur in sufficient concentrations. The analytical procedures are described in an appendix. Electric and gamma-ray logs, not reported previously, are included for all counties in the study area.—ESL

04696 **Gerlach, Arch C.** Utilization of orbital data through international and national organization [abs.]: Assoc. Am. Geographers Annals, v. 57, no. 4, p. 788, 1967.

04404 **Gibbs, Ronald J.** Quantitative X-ray diffraction analysis using clay mineral standards extracted from the samples to be analysed: Clay Minerals, v. 7, no. 1, p. 79-90, illus., table, 1967.

In the quantitative X-ray diffraction analysis of a series of samples, the problems arising from the variable compositions and degrees of crystallinity of clay minerals were overcome to a great extent by the use of standards extracted from the samples. Procedures are given for separation of the montmorillonite standard by differential settling of Na-montmorillonite solvated in an ethanol solution and for isolation of the kaolinite, mica, and chlorite standards by density separation of their Na-forms in thallous formate. Calibration curves were prepared from the X-ray diffractograms obtained for series of known mixtures of Ca-forms of the standards and the internal standard boehmite using both powder and smear-oriented mounting techniques.—Author's abstract

04455 **Gibson, Thomas G.; Walker, William M.** Flotation methods for obtaining Foraminifera from sediment samples: Jour. Paleontology, v. 41, no. 5, p. 1294-1297, 1967.

Experiments on sediment samples from the Tertiary and Recent of the Atlantic Coast show that a variable, but relatively small proportion (6-71 percent) of the Foraminifera float in carbon tetrachloride. The flotation is selective by species, giving proportions significantly different from the actual. These problems are overcome by the use of bromoform, which allows recovery of over 95 percent of the specimens. Due to its high efficiency, bromoform should be used for ecologic and paleoecologic studies involving relative and absolute abundances. Bromoform is not as lethal a compound as carbon tetrachloride, but all of the heavy liquids should be used only in a good ventilating chemical hood.—Authors' abstract

04858 **Gilliam, Jeanne A.; Kapp, Ronald O.; Bogue, Robert D.** A post-Wisconsin pollen sequence from Vestaburg Bog, Montcalm County, Michigan: Michigan Acad. Sci., Arts and Letters Papers 1966, v. 52, p. 3–17, illus., 1967.

Vestaburg Bog is developed on a recessional moraine, probably on the site of a buried ice block, in a 60-mile-wide belt forming an ecotone between the northern coniferous forest climax and the mixed hardwood forest. Pollen diagrams for two cores correlate C-14 dates, pollen zones, and stratigraphy. The sequence is similar to that from New England and the Great Lakes region, with Spruce, Pine, Hardwood, and Ragweed Pollen Zones. The end of the Spruce Pollen Zone is dated at 10,328±436 B.P. Pine seems to have migrated into the area from the east. The establishment of *Tsuga canadensis* is dated at 7,982±250 B.P. The warm-dry hypsithermal interval may be reflected by a flux in percentages of pine and oak. Settlement of the area is reflected in ragweed pollen in surface sediments.—ESL

Gilliland, William N. *See* Gundersen, Wayne C. 04434

04634 **Glasser, F. P.** New data on kentrolite and melanotekite—Ternary phase relations in the system $PbO-Fe_2O_3-SiO_2$: Am. Mineralogist, v. 52, nos. 7–8, p. 1085–1093, illus., tables, 1967.

A phase identical with melanotekite is readily prepared by heating the composition $2PbO{\cdot}Fe_2O_3{\cdot}2SiO_2$ in an air atmosphere at 650°–700°C. Results of heating experiments and crystallographic examination of naturally occurring melanotekite confirm this formula. Laboratory studies to determine the subsolidus compatibility triangles show that at 650°C, melanotekite can coexist with the following minerals: alamosite, quartz, hematite, magnetoplumbite, and plumboferrite. In addition a new ternary phase has been encountered.—*from* Author's abstract

04478 **Glen, William.** In quest of a multiple first: Jour. Paleontology, v. 41, no. 5, p. 1281, illus., 1967.

In 1821 Granger published the first paleobotanical paper by an American, dealing with North American plant fossils. The specimens were found associated with coal near Zanesville, Ohio, and included a large, flabelliform leaf resembling *Psygmphyllum, Platyphyllum*, and *Ginkgophyton*. Present whereabouts of the specimens is unknown, and pertinent information is sought by the author.—SHM

04592 **Glover, Lynn, 3d; Mattson, Peter H.** The Jacaguas Group in central-southern Puerto Rico, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1966: U.S. Geol. Survey Bull. 1254-A, p. A29–A39, illus., 1967.

04689 **Glover, Lynn, 3d.** Cuyón Formation of east-central Puerto Rico, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1966: U.S. Geol. Survey Bull. 1254-A, p. A18–A19, illus., 1967.

04741 **Glover, Robert E.; Frink, John W.; Phillips, H. Boyd.** Snake Plain analog studies: Am. Soc. Civil Engineers Proc., v. 93, paper 5670, Jour. Irrigation and Drainage Div., no. IR4, p. 97–110, illus., 1967.

Design, construction, and operation of an electric analog to correlate existing geologic and hydrologic data, and to guide future exchange pumping and recharge operations in the Snake River Plain area in Idaho are described. Beneath this plain, fissured lavas form an aquifer of exceptional permeability covering an area of about 12,000 sq mi. Ground-water discharge accounts for 4,500,000 acre-ft of the 7,000,000 acre-ft now flowing uncontrolled out of the area each year. The analog will be used to study the possibilities of developing this ground-water reservoir to supply pumped irrigation water and to store excess surface flows as recharge. Authors' abstract

Godson, Richard H. *See* Watkins, Joel S. 04750

04769 **Goebel, Edwin D.** Stratigraphy of Mississippian rocks in western Kansas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 941B, 1967.

04623 **Goetz, Alexander Franklin Hermann.** Infrared 8–13μ spectroscopy of the Moon and some cold silicate powders [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 741B–752B, 1967.

04502 **Gold, David P.** Local deformation structures in a serpentinite, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 200–202, illus., 1967.

Two unoriented hand specimens of serpentinite from the Thetford, Quebec, area are described. One has seams of magnetite along which measurable movement has taken place. The serpentine fiber bands are distributed as curved surfaces tending to co-planar with the magnetite seams. The magnetite seams parallel conjugate shear directions (as in triaxial conditions) and the fiber bands tend toward the planes of shear stress. The movement in the other specimen was plane rotational between 37° and 40° about the center of rotation. The longest fiber is farthest from the seam; a second generation fiber has developed close to the seam; seam 1 (earlier) is slightly discordant (10°) to the major fiber bands; seam 2 is concordant to fibers in the F/W_2–H/W_1, H/W_2–F/W segments and discordant in the H/W_1–H/W_2, F/W_1–F/W_2 segments. Origin is discussed.—HRC

04503 **Gold, David P.** Alkaline ultrabasic rocks in the Montreal area, Quebec, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 288–302, illus., tables, 1967.

The Monteregian petrographic province contains stocks, necks, dikes, plugs, and sills; the activity was controlled by deep-seated faults. The types of rocks change from east to west, suggesting migration of magma, with outlets having formed vertical magma chambers at intervals. The numerous rocks named are plotted in basalt tetrahedra of Yoder, Tilley, and Schairer. The mineralogy and petrology of 12 of the bodies are summarized. The peridotite-pyroxenite-gabbro-diorite-syenite association is consistently developed, with but a small part being ultrabasic or ultramafic. Structural traps collected volatiles leading to the development of the undersaturated peralkaline nepheline-rich trend at Oka, where carbonatite and other ultrabasics were formed. Fractionation of standard alkali basalt magma produced the association.—HRC

04519 **Goles, Gordon G.** Trace elements in ultramafic rocks, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 352–362, table, 1967.

A review of recent analytical results for 23 elements plus the rare earths from lanthanum to lutetium, is given. For many elements, the overall average abundance is insignificant as the abundances do not constitute a single population. There are differences among trace elements for alpine intrusions, ultramafic nodules, and their host basalts, especially Na, K, Rb, Sr, Co, Ni, Th, and the Rb/Sr ratio. Co seems insensitive to mineralogy, whereas Ni is very sensitive. The nature of the sampling needs investigation, and since alpine intrusives are residual in nature, they could not give rise to basalts by any fractionation procedure. They do not make up a significant fraction of the upper mantle.—HRC

Gordon, Mackenzie, Jr. *See* Yochelson, Ellis L. 04376

Gordon, Norma S. *See* Donohue, Mildred D. 04877

04820 **Gradziński, Ryszard; Radomski, Andrzej.** Pizolity z jaskiń kubańskich (Pisoliths from Cuban caves) [in English with Polish summ.]: Polskie. Towarz. Geol. Rocznik, v. 37, no. 2, p. 243–266, illus., tables, 1967.

Pisoliths in Cuban caves are found in the flat bottom of caves (pisolithic fields) and in small-scale depressions; differences are recorded in the internal structure and shape of the pisoliths. In pisolithic fields, formed during seasonal flooding of the cave floor, thick uncemented layers of pisoliths cover considerable areas. These pisoliths, observed in caves of Caguanes Peninsula, show no evidence of abrasion, and have a predominance of spheroidal forms, smaller bulk specific gravity, absence of aphanitic calcite, and inconspicuous recrystallization. Those in small depressions,

as in Cueva del Amistad, were formed either completely or partially immersed in water; they have diversity in shape, ubiquitous evidence of abrasion, larger specific gravity, aphanitic primary laminae, and common evidence of recrystallization.—GDC

Grant, F. *See* VanHeerden, W. L. 04451

Gray, Donald H. *See* Chilingar, George V. 04316

04402 **Green, Cecil H.; Peavey, R. C.** In memoriam—Lloyd Viel Berkner, 1905–1967: Am. Geophys. Union Trans., v. 48, no. 4, p. 893–895, portrait, 1967.

04533 **Green, D. H.** High-temperature peridotite intrusions, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 212–222, table, 1967.

A small group of peridotites, one of which is at Mt. Albert, Quebec, has well-defined metamorphic aureoles of dynamothermal character which indicate temperatures of 1,000°C for the ultramafic intrusives. The chemistry of the pyroxenes is consistent with this estimate. These are different from other alpine-type peridotites. The peridotites have a compositional banding caused by gravity stratification, and the rocks have higher CaO, Al_2O_3 and Na_2O than other alpine-type intrusions. These rocks crystallized initially under high load pressure, were deformed, moved to higher levels, and recrystallized.—HRC

04578 **Greenwood, H. J.** Mineral equilibria in the system $MgO-SiO_2-H_2O-CO_2$, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 542–567, illus., tables, 1967.

Advances in applications of thermodynamic theory to rock-forming processes have emphasized the critical role played by composition of pore fluid in a rock. Contributions to the theoretical aspects of this problem made in recent years are presented. Experiments made in the presence of supercritical gas mixtures in which more than one gaseous component enters into the reaction are described. Geologic applications include occurrences of magnesite, talc, and quartz. A profound effect is exerted on the sequence of metamorphic reactions by competition between solids and fluid for reactants. This effect is probably of importance in all examples of progressive metamorphism of impure carbonate rocks.—ESL

04874 **Griffiths, John C.** Scientific method in analysis of sediments: New York and London, McGraw-Hill Book Co. (Internat. Ser. Earth and Planetary Sci.), 508 p., illus., tables, 1967.

To solve research problems in geoscience by means of the scientific method, it is essential to define the problem, state possible solutions or hypotheses, and test the hypotheses on the basis of data. Although illustrative examples are selected from petrographic analysis of detrital sediments, the approach of the book is general and may be applied to any field which permits isolation and definition of a population and its elements. Chapter headings are: scientific method; sampling and properties of sedimentary rocks; measurement of grain size; expression of measured data; measurement of grain shape, grain fabric, grain packing, mineral composition, and derived properties; data processing and reduction; frequency distributions; relationship between mean and dispersion; commoner tests of significance; analysis of variance; other experimental designs; measurement of association among variates; and some principles of experimental inquiry.—MCM

04464 **Groff, S. L.** A summary description of geology in the Smith River valley, Meagher County, Montana, *in* Centennial basin of southwest Montana—Montana Geol. Soc., 18th Ann. Field Conf. 1967, Guidebook: [Billings, Mont.] Montana Geol. Soc., p. 93–102, illus., tables, 1967.

The valley is in a structurally complex region between the Big Belt, Little Belt, and Castle Valley Uplifts. Precambrian Belt Series rocks overlie gneiss, and are in turn overlain by Cambrian, Devonian, Mississippian, Pennsylvanian, Jurassic, Cretaceous, Tertiary, and Quaternary rocks conservatively estimated to be 26,000

feet thick. Considerable intrusion occurs, chiefly Tertiary; Tertiary and Quaternary extrusive rocks are also common. Recent high-angled, north to northwest trending faults are superimposed upon the low-angled fault planes of the disturbed belt, of which this is the eastern edge. No specific mineral deposits are present, but a large magnetic anomaly is discussed; it could be a peridotite dike. A geologic map is included.—HRC

04300 **Grommé, C. S.; Merrill, R. T.; Verhoogen, J.** Paleomagnetism of Jurassic and Cretaceous plutonic rocks in the Sierra Nevada, California, and its significance for polar wandering and continental drift: Jour. Geophys. Research, v. 72, no. 22, p. 5661–5684, illus., tables, 1967.

Directions of natural remanent magnetization (NRM) have been determined at 13 sites in two intrusive bodies in the western Sierra Nevada, the Guadelupe Mountains complex and the Bucks batholith, whose K–Ar ages are 136 and 129–142 m.y., respectively. The pole position corresponding to mean NRM directions at all sites after a-c demagnetization is lat 54° N., long 74° W., which is not significantly different from five published poles from widely separated North American rocks that are 84 to 124 m.y. old. This concordance strongly favors a geocentric dipolar geomagnetic field configuration and further indicates that from 138 to about 84 m.y. ago polar wandering relative to North America did not occur; apparent polar wandering during Mesozoic time was probably due entirely to continental drift.—DBV

Grommé, C. S. *See* Dalrymple, G. B. 04666

04743 **Grossman, Stuart.** Ecology of Rhizopodea and Ostracoda of southern Pamlico Sound region, North Carolina—Pt. 1, Living and subfossil rhizopod and ostracode populations: Kansas Univ. Paleont. Contr. 44, Ecology, art. 1, p. 1–82, illus., tables, 1967.

Ninety-seven species in 43 genera from 159 stations (57 cores, 82 Petersen-dredge, and 20 sieve samples) over 1,200 sq mi are studied. The assemblages represent estuarine, open-sound, salt-water lagoon, tidal-deltamarsh biofacies. Salinity, vegetation, and tidal currents seem to have the greatest influence on the fauna. Low pH, currents and waves, and turbidity account for low abundance. Low $CaCO_3$ and low pH account for lack of calcareous species in estuaries. The nature of the substrate seems to have little influence. Cores show little change over the recent past though the estuaries have been subjected to flooding by increased salinity water which may remain long enough to establish a more marine-type fauna.—Author's abstract

04835 **Grosso, Gerald H.** Cave life on the Palouse: Nat. History, v. 76, no. 2, p. 38–43, illus., 1967.

Exploratory digging in Marmes rock shelter along the Palouse River in Washington, just above its juncture with the Snake, has revealed skeletons of prehistoric Indians over 7,500 years old. Signs of occupation extend several layers below the Mazama ash layer and are dated between 10,000 and 11,000 years ago; some of the artifacts are described. The cave is believed to have been formed when the last great Ice-Age flood swirled through the canyon, which may be the source of Indian legends about a great flood. The excavation is being done before flood waters back up from Lower Monumental Dam and bury the rock shelter.—ESL

Groth, Peter K. H. *See* Habib, Daniel. 04882

04744 **Gualtieri, J. L.** Geologic map of the Brodhead quadrangle, east-central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-662, scale 1:24,000, section, text, 1967.

Petroleum has been produced in noncommercial quantities in a small syncline of low closure from Boyle Dolomite in the Brodhead quadrangle. The lower 100–125 feet of the Nancy Member of the Borden Formation consists of nearly silt-free clay shale probably suitable for bricks and tile. The Ste. Genevieve Limestone Member of the Newman Limestone contains beds of sufficient purity to be used

for road metal, concrete aggregate, and agricultural lime. Siltstone beds in the Wildie Member of the Borden have been quarried for local use as foundation blocks and building stones. Gravel in the Dix River and tributary streams is used locally for fill and road metal.—MCM

Guild, P. W. *See* Carr, M. S. 04736

04704 **Guilday, John E.; Adam, Eleanor K.** Small mammal remains from Jaguar Cave, Lemhi County, Idaho: Tebiwa, v. 10, no. 1, p. 26–36, illus., tables, 1967.

A minimum of 13 species of Rodentia, 5 species of Lagomorpha, and 13 species of medium to small sized Carnivora are discussed. The collared lemming *Dicrostonyx* cf. *torquatus*, and the black-footed ferret, *Mustela nigripes*, are reported from Idaho for the first time. The remaining are still known in the area. Climatic change during deposition is shown by normally incompatible species being found together. Absence of southern forms and presence of hearths dating 11,000 B.P. make it probable that deposition began in late Wisconsin (Pinedale) times and was completed before the Altithermal Period.—*from* Authors' abstract

04434 **Gundersen, Wayne C.; Gilliland, William N.** Stratigraphic reflections of the Sanpete–Sevier Valley anticline of central Utah: New York Acad. Sci. Trans., ser. 2, v. 29, no. 6, p. 686–699, illus., 1967.

The structural characteristics of this anticline were summarized by Gilliland (1963). It trends north–south for at least 65 to 70 mi underneath the Sanpete and Sevier Valleys. In addition to the Laramide orogeny, diastrophism occurred in the late Cretaceous and Paleocene. Formations deposited during that time thin toward the anticline, and the Price River, North Horn, and Flagstaff Formations rest unconformably on each other here, although in other areas they are conformable. A stratigraphic analysis of each formation is given and isopach maps included show effects of topographic highs.—ESL

04445 **Guthrie, Daniel A.** *Paeneprolimnocyon*, a new genus of early Eocene limnocyonid (Mammalia, Creodonta): Jour. Paleontology, v. 41, no. 5, p. 1285–1287, illus., 1967.

Paeneprolimnocyon, a new genus of limnocyonid (type species, *P. amissadomus*, n.sp.) from the Lost Cabin Member of the Wind River Formation, early Eocene of Wyoming, is described. *P. iudei* is removed from *Prolimnocyon* (herein redefined) and referred to *Paeneprolimnocyon*.—Author's abstract

04882 **Habib, Daniel; Groth, Peter K. H.** Paleoecology of migrating Carboniferous peat environments: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 3, no. 1, p. 185–195, illus., 1967.

Evidence is presented for a genetic relationship between distribution of spore-and-pollen assemblages in Lower Kittanning coal and distribution of marine and nonmarine facies in overlying Lower Kittanning shale. Previously published geochemical, lithological and invertebrate faunal criteria separate the facies of the shale to coincide geographically with distribution of assemblages in the upper zones of the coal seam. Palynological zones in the shale, as well as the relationship between sulfur in the seam and the facies of the overburden, support the hypothesis of factors causing spatial distribution of spore-and-pollen assemblages in the coal and overburden. With marine transgression in the coal swamp, the lycosporid lycopods migrated toward fresh areas, and were replaced by lycopods disseminating *Densosporites*.—GDC

04383 **Hackman, Robert J.** Geologic evaluation of radar imagery in southern Utah, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D135–D142, illus., 1967.

A comparison of radar imagery with conventional aerial photography shows that radar imagery has some distinct advantages. It has all-weather, day or night capability of imaging large areas of terrain. Side-looking radar produces a "shadow" enhancement effect that shows greater topographic detail, important to observation of many geologic features. One structural fault that could be only

poorly discerned on conventional photography was clearly visible on radar imagery. Calcareous and gypsiferous sedimentary rocks were shown as very light tones of gray in contrast to darker sandstones and shales. These contrasts were reversed and less conspicuous on the conventional aerial photography. However, many of the rock units, readily distinguishable on the photography, could not be positively differentiated on the radar imagery.—Author's abstract

04850 **Hagner, Arthur F.; Collins, Lorence G.** Magnetite ore formed during regional metamorphism, Ausable magnetite district, New York: Econ. Geology, v. 62, no. 8, p. 1034–1071, illus., tables, 1967.

Geological and geochemical study suggests that, during regional metamorphism, iron migrated from the host-rock gneisses toward regions of low relative pressure and high oxygen activity in shear zones, forming the orebodies. Original accessory magnetite of host rocks, the principal source of iron, is believed to result from release of iron as Fe–Mg ratio of silicates decreases during progressive metamorphism. Iron content of host rocks decreases toward orebodies, and calculations show that amount apparently removed from bordering gneiss is quantitatively sufficient to explain orebodies.—WSW

04347 **Hales, A. L.; Doyle, H. A.** P and S travel time anomalies and their interpretation: Royal Astron. Soc. Geophys. Jour., v. 13, no. 4, p. 403–415, illus., tables, 1967.

Study of the deviations of P and S traveltimes from the J–B tables at teleseismic distances has shown that there are regional differences in traveltime. Both P and S are early in the central and eastern United States, late in the western United States. The differences have a range of about three seconds for P and eight seconds for S. It can be deduced from the relation between traveltime residuals (1) that the change in shear velocity is approximately one and one-quarter times the change in P velocity, (2) that the observations imply a difference in Poisson's ratio between the two regions, and (3) that a model in which the shear modulus μ, alone varies, the compressibility, k, remaining sensibly constant, fits the data best.—*from* Authors' summary

04828 **Hall, Henry T.** Application of thermochemical data to problems of ore deposition [corrections to 1966 discussion of paper by H. D. Holland, 1965]: Econ. Geology, v. 62, no. 8, p. 1108, tables, 1967.

Free-energy data for some ternary sulfide phases at 400°C as given in an earlier discussion by the author (ibid., v. 61, no. 3, p. 622–623, 1966) are corrected.—WSW

04335 **Hall, Henry Thompson.** The systems Ag–Sb–S, Ag–As–S, and Ag–Bi–S—Phase relations and mineralogical significance [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 1, p. 233B–234B, 1967.

04456 **Hall, John W.** Invalidity of the name *Chrysotheca* Miner for microfossils: Jour. Paleontology, v. 41, no. 5, p. 1298–1299, illus., 1967.

The generic name *Chrysotheca* for sac-like microfossils which are supposed to represent moss perianths is invalid. It is a homonym of names earlier applied to unicellular, amoeboid, yellow-brown algae. *Costatheca* is proposed for the fossil forms.—Author's abstract

04857 **Hall, John W.; Norton, Norman J.** Palynological evidence of floristic change across the Cretaceous-Tertiary boundary in eastern Montana (U.S.A.): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 3, no. 1, p. 121–131, illus., tables, 1967.

The percentage contribution of the gymnosperms and dicotyledons of the pollen flora of the latest Cretaceous and earliest Tertiary of mid-continent U.S.A. shows differences which may prove to be of value in delimiting these two periods. Absolute number of species declines from Cretaceous to Tertiary, but the percentage contribution of fern species remains the same. The percentage of dicotyledon species is high in the Cretaceous and low in the Tertiary, and that of the gymnosperms is lower in the Cretaceous than in the Tertiary. These differences may be related

to moderate climatic deterioration across the Cretaceous–Tertiary boundary.—Authors' abstract

Hallan, A. *See* Duff, P. McLaren D. 04714

04729 **Hamilton, Stanley K.** Copper mineralization in the upper part of the Copper Harbor Conglomerate at White Pine, Michigan: Econ. Geology, v. 62, no. 7, p. 885–904, illus., 1967.

Native copper is the principal ore mineral where copper occurs in the upper few feet of sandstone immediately below the Nonesuch Shale. The copper-bearing rocks belong to a chloritic sandstone facies, 1 to 20 feet thick, at the top of the hematitic sandstone facies that characterizes the Copper Harbor Conglomerate as a whole. The native copper is mostly confined to the chloritic sandstone where it contains interstitial carbonaceous matter. Distribution of native copper and carbonaceous matter is controlled by primary permeability, and both are abundant in strongly crossbedded rocks. Mineralization is believed to be diagenetic.—WSW

04550 **Hampton, Loyd Donald.** Acoustic properties of sediments [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 1041B, 1967.

04644 **Hanor, Jeffrey S.** Regional control and zoning of barite in eastern North America [abs.]: Econ. Geology, v. 62, no. 6, p. 870, 1967.

Hanshaw, Bruce B. *See* Back, William. 04852

04507 **Hardin, James W.; Cooper, Arthur W.** Mountain disjuncts in the eastern Piedmont of North Carolina: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 139–150, illus., table, 1967.

It is concluded that the disjunct distribution pattern for vascular plants and bryophytes along the eastern edge of the Piedmont had its origin during the Wisconsin. Forests more mesophytic than those now occurring over the Piedmont, were distributed more continuously. As climates warmed, these forests became dissected, with limited stands remaining in areas of slightly cooler, more moist climate and suitable soil conditions.—ESL

04853 **Harding, James L.** The Campeche lithic suite, Yucatán shelf, Mexico, *in* Yucatán field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7: New Orleans, La., New Orleans Geol. Soc., p. 79–99, illus., 1967.

Campeche Bank on the continental shelf northwest of the Yucatán Peninsula consists of Pleistocene and older carbonate rocks overlain by a veneer of unconsolidated calcilutites and calcarenites up to 12 m thick. Core and grab samples of this veneer show fragments of lithoclasts representative of the underlying indurated limestones mixed with relics associated with Pleistocene–Holocene sea-level fluctuations. Six groups—biomicrites, oomicrites, biosparites, oosparites, midstones and boundstones—are described with genetic implications, and are mapped in four alternating bands of micrite and sparite units, based on distribution and cement mineralogy of lithoclasts. Subreef mounds in a roughly parallel alinement suggest eolianite dunes formed during a Wisconsinan stillstand.—GDC

Harlow, Francis H. *See* Sutherland, Patrick K. 04465

04483 **Harper, Charles W., Jr.; Towe, Kenneth M.** Shell structure of the brachiopod *Pholidostrophia (Mesopholidostrophia) nitens* from Gotland: Jour. Paleontology, v. 41, no. 5, p. 1184–1187, illus., 1967.

Nacreous luster in this species is due to a natural diffraction grating effect produced in the surface layers of the shell by a finely criss-crossed pattern in the surface layers of calcite.—REG

Harris, D. C. *See* Chao, G. Y. 04633

04697 **Harris, Stuart A.** The meaning of till fabrics [abs.]: Assoc. Am. Geographers Annals, v. 57, no. 4, p. 789–790, 1967.

04304 **Harwood, David S.; Berry, William B. N.** Fossiliferous Lower Paleozoic rocks in the Cupsuptic quadrangle, west-central Maine, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D16–D23, illus., table, 1967.

The Taconic unconformity in the Cupsuptic quadrangle separates conglomerate, limestone, and calcareous slate of Silurian age (Llandovery and Ludlow) from a eugeosynclinal sequence of slate, greenstone, and graywacke of Middle Ordovician and older age. Middle Ordovician graptolites, indicative of zone 12, *Climacograptus bicornis*, in black slate of an unnamed unit establish the equivalence of this unit to the Beauceville Formation near Magog, Quebec; the lower part of the Normanskill Shale of New York; various fossiliferous units in northeastern Maine; and date the Partridge Formation, and at least part of the Dixville Formation, of New Hampshire and Maine.—Authors' abstract

04597 **Haskin, Larry A.; Schmitt, Roman A.** Rare-earth distributions, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 234–258, illus., table, 1967.

Findings of recent geochemical studies of rare-earth elements demonstrate implications to understanding of the Earth and meteorites. Abundance in terrestrial matter is divided between sedimentary and igneous rocks. The average relative rare-earth pattern of the Earth as a whole is the same as chondrites, but the crust is enriched in light lanthanides. Partition of the rare earths is a possible mechanism for this, but very little is understood about how they are fractionated. Highest absolute contents of rare earths are found in rocks with the most strongly fractionated patterns. Relative abundance distributions are the same in all classes of chondrites. Patterns for chondrules from unequilibrated chondrites are only slightly different from whole-meteorite patterns, but in equilibrated specimens, the rare earths are distinctly fractionated in the chondrules. Partition probably has accompanied the metamorphism producing the equilibration.—ESL

04401 **Hatch, Norman L., Jr.** Redefinition of the Hawley and Goshen Schists in western Massachusetts: U.S. Geol. Survey Bull. 1254-D, p. D1–D16, illus., 1967.

Emerson's Hawley Schist, renamed the Hawley Formation, is redefined to include the graphitic schists that are interbedded with the metavolcanic rocks of the original definition. A Middle Ordovician age is assigned to the formation. Emerson's Goshen Schist, renamed Goshen Formation, is redefined to include all gray schists, cyclically bedded rocks, and quartzites between the top of the underlying Hawley and the base of the lowest calcareous bed in the overlying Waits River Formation. The Goshen is dated as Silurian and Devonian.—NLH

04854 **Hawkins, Daniel B.** Zeolite studies—[Pt.] 2, Ion-exchange properties of some synthetic zeolites: Materials Research Bull., v. 2, no. 11, p. 1021–1028, table, 1967.

Studies of the calcium–strontium ion exchange properties of synthetic mordenite, clinoptilolite, ferrierite and yugawaralite show unequivocally that strontium selective zeolites can be prepared by synthesizing the zeolite in the presence of strontium. Synthetic strontium mordenite showed strontium–calcium separation factors ranging from 8.4 to 3.5 depending upon the alumina to silica ratio of the zeolite. Synthetic calcium mordenite showed separation factors of from 0.5 to 1.6. The ion-exchange behavior of synthetic strontium clinoptilolite was similar to that of strontium mordenite. Strontium ferrierite and strontium yugawaralite are not as strontium selective as clinoptilolite or mordenite and do not appear to warrant further study at present.—Author's abstract

04641 **Hawley, John W.** K–Ar ages of late Cenozoic basalts in Dona Ana County, New Mexico [abs.], *in* Guidebook of Defiance-Zuni-Mt. Taylor region, Arizona and New Mexico—New Mexico Geol. Soc., 18th Field Conf. 1967: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 226, 1967.

04340 **Hayes, J. M.** Organic constituents of meteorites—A review: Geochim. et Cosmochim. Acta, v. 31, no. 9, p. 1395–1440, illus., tables, 1967.

A critical review of all meteorite organic chemical analyses published since 1900 suggests that many reported compound identifications are insufficiently supported by present standards, and that the search for compounds possibly indicating extraterrestrial life has been a poorly focussed effort. A brief review of the characteristics and thermal histories of the various classes of chondrites shows that unequilibrated ordinary chondrites and ureilites might also be expected to contain organic material. Possible origins of meteorite organic compounds and the relationships of these origins to theories of meteorite origin are discussed briefly.—DBV

04327 **Hayes, Miles O.; McCormick, C. Larry.** Sedimentation in estuaries, with reference to the Merrimack and Parker Rivers, Massachusetts, *in* Economic geology in Massachusetts—Conf., Amherst, 1966, Proc.: Amherst, Mass., Graduate School, Univ. Massachusetts, p. 547–558, illus., 1967.

This report presents an outline of some of the important factors affecting sedimentation in three estuarine areas that have been studied in detail—the south Texas coast, the Wadden Sea, and the Wash (Great Britain)—and these are compared with the Parker and Merrimack Rivers, major estuaries on the northeast Massachusetts coast. In all areas climatic factors, winds and waves, organic processes, river influx, and storms play at least a minor role in sedimentation. Influence of tidal current activity on estuarine sedimentation is increased as the tidal range is increased. The northeast Massachusetts coast most closely resembles the Wadden Sea which is the site of development of many classic concepts of estuarine sedimentation.—MCM

04444 **Hazel, Joseph E.** Corrections—Classification and distribution of the recent Hemicytheridae and Trachyleberididae (Ostracoda) off northeastern North America: Jour. Paleontology, v. 41, no. 5, p. 1284–1285, 1967.

Several inadvertent errors which appeared in an earlier paper by Hazel (1967) dealing with the classification of the genera of the Hemicytheridae and Trachyleberididae are corrected. Modifications are made with respect to the genera *Verrucocythereis, Basslerites, and Baffinicythere.*—JFM

04723 **Hazen, Scott W., Jr.** Assigning an area of influence for an assay obtained mine sampling: U.S. Bur. Mines Rept. Inv. 6955, 75 p., illus., tables, 1967.

The area of influence assigned to an assay is the shortest interval over which successive assays show independence at the 90 percent confidence interval using the mean-square-successive-difference test. The area of influence at the Climax molybdenum deposit is less than two feet in the 0.2- to 0.4- percent grade zone studied, that at the Cebolla Creek titaniferous iron deposit ranges from 4 to 36 feet, San Manuel copper probably 100 to 200 feet, Piedra Hueca copper 53–66 feet, and Butte copper 6–32 feet. The relation between assays was further examined by linear correlation tests. Apparently the mean-square-successive-difference test measures some factors related to the characteristics of mineralization, while the linear correlation coefficient is related to intensity of mineralization.—KFF

04735 **Hedges, James.** Mixture-solution hollows in Worden's Cave, Iowa: Caves and Karst, v. 9, no. 5, p. 41–44, illus., 1967.

Worden's Cave, in southern Jackson County, is developed in soft, porous, massive Hopkinton Dolomite of Silurian age. The ceiling contains two domes similar to Lange's negative stalactites, but without vertical flutings in the domes. There is no insoluble caprock above the dolomite to form Pohl's vertical shafts. It is concluded that the domes formed when the cave was full of water, as a result of *Mischungskorrosion,* when saturated water of a different carbonate content, entered along joints. *Korrosionskolk*, mixture-solution hollow, should be used in referring to these features.—ESL

04318 **Heezen, Bruce C.** Introduction, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. ix–xi, 1967.

Quaternary history of ocean basins is interpreted chiefly from study of the stratigraphy and paleontology of deep-sea sediment cores. Applications of radiocarbon dating, the oxygen-isotope paleotemperature method, and ecology of Foraminifera and other microfauna, to correlations of the cores are discussed in the following papers of this symposium. The most significant recent advance in Quaternary stratigraphy is the establishment of a paleomagnetic sequence of polarity reversals; the rapidly emerging paleomagnetic correlation techniques may hold the key to the solution of the Pliocene–Pleistocene boundary problem.—VMJ

04452 **Heinrich, E. William; Vian, R. W.** Carbonatitic barites: Am. Mineralogist, v. 52, nos. 7–8, p. 1179–1189, tables, 1967.

Carbonatitic barites differ from those of noncarbonatitic origin in normally containing some Sr and in having a much wider total range of Sr content. Carbonatitic barites are late magmatic (rarely) to hydrothermal species, occurring commonly in late-generation carbonatites that are mineralogically and texturally complex. Ankerite, RE carbonates, fluorite, sulfides and quartz are common associates. Unlike early magmatic carbonatitic calcites and dolomites whose Ba and Sr contents vary regularly with relative age, barites from carbonatites show much greater variability in Sr content both among those of different paragenetic positions and within those of a single paragenetic type, further attesting to their formation by hydrothermal fluids in a declining-temperature environment and a locally variable Ba/Sr ratio in the solutions.—Authors' abstract

04573 **Helgeson, Harold C.** Solution chemistry and metamorphism, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 362–404, illus., tables, 1967.

Progress has been made in the application of thermodynamic principles to the study of metasomatic processes. The nature and extent of compositional changes in mineral assemblages and interstitial solutions resulting from equilibration of sea water with a clastic sediment at elevated temperatures is examined. The Salton Sea, Calif., geothermal system is used to define these calculations. Because the aqueous phase is a concentrated brine, activity coefficients at elevated temperatures are required to relate ion activities to silicate phase relations in the metamorphosed sediments. These are derived together with equilibrium constants for phase boundaries in the system $MgO–CaO–K_2O–Na_2O–Al_2O_3–SiO_2–H_2O–CO_2$ at 300°C.—ESL

04629 **Helley, Edward John.** Sediment transport in the Chowchilla River basin—Mariposa, Madera, and Merced Counties, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 1, p. 234B, 1967.

04770 **Helton, Walter Lee.** Lithostratigraphy of the Conasauga Group between Rogersville and Kingsport, Tennessee [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 941B–942B, 1967.

04339 **Henderson, William Garth.** Physico-chemical phenomena of soil materials [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 12, pt. 1, p. 4383B–4384B, 1967.

Hendrickson, Gerth E. *See* Doonan, Charles J. 04840

04549 **Hester, B. W.** Geology of the silver deposits near Miller Lake, Gowganda: Canadian Mining and Metall. Bull., v. 60, no. 667, p. 1277–1286, illus., 1967.

Native silver and cobalt arsenides occupy narrow vein fractures in and around gently dipping diabase intrusives in a structural environment very similar to that at Cobalt, Ontario. A generalized paragenesis of the vein-filling minerals, based on megascopic features, shows the silver to have been followed by a well defined sequence of calcite and quartz. Regional stresses were transmitted to the diabase sheet mainly through rigid dikes of an earlier diabase which are enclosed in incompetent, serpentinized,

basic and ultrabasic rocks over the ore zones. After the evolution of the fracture pattern, stress exceeded the elastic limit and plastic deformation occurred along narrow zones around the already established fractures. Shear trajectories branched from the fractures. These are cycloidal in form and are typical of this type of deformation. Mineralization took place below the elastic limit as stress decreased.—*from* Author's abstract

04403 **Hewitt, D. F.** Phosphate in Ontario: Ontario Dept. Mines Mineral Resources Circ. 6, 63 p., illus., tables, 1967.

This circular describes 77 deposits of apatite of four principal types: silicated marble with disseminated apatite, metamorphic pyroxenite with apatite, hydrothermal vein deposits, and alkaline–carbonatite complexes. Recent discovery of the fourth type, with large tonnages of apatite and magnetite, has revived interest in the Ontario phosphate industry. Production of apatite has amounted to 35,627 tons, valued at 394,519 dollars between 1892 and 1951.—ESL

04868 **Hibbard, Claude W.** New rodents from the late Cenozoic of Kansas: Michigan Acad. Sci., Arts and Letters Papers 1966, v. 52, p. 115–131, illus., 1967.

During the past 30 years a large series of isolated teeth and jaws of various rodents has been recovered from Pliocene and Pleistocene deposits in the Meade basin. The present study includes only the pocket gophers, Geomyidae, from the Rexroad Formation, and the packrats, Cricetidae, from the Rexroad and Crooked Creek Formations. Systematic descriptions of fossils from the Saw Rock Canyon, Fox Canyon, Rexroad, and Borchers local faunas are given. This series of specimens has allowed a better understanding of the individual and age variation within the different populations.—ESL

04438 **Hilpert, Lowell S.** Summary report on the geology and mineral resources of the Bear River Migratory Bird Refuge, Box Elder County, Utah: U.S. Geol. Survey Bull. 1260–C, p. C1–C10, illus., 1967.

Part of the 64,895 acres of the Bear River Migratory Bird Refuge has been proposed for inclusion in the National Wilderness Preservation System. Rocks under the refuge make up part of a downthrown, eastward-tilted structural block, the lower part composed of complexly faulted Precambrian and Paleozoic rocks, many thousands of feet thick, and the upper part, unconsolidated sediments ranging from a few hundred to several thousand feet thick. Surficial rocks are mud, clay, silt, and fine sand. There are no known mineral deposits of economic interest, and no record of leasing or mining. Small pockets of methane gas may occur but would be of minor commercial importance. Brines may exist at depths of several hundred feet, but they probably have been diluted by inflowing fresh water.—*from* Author's abstract

04360 **Hirashima, George T.** A determination of the daily mean discharge of Waiakea Pond Springs, Hilo, Hawaii, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575–D, p. D242–D246, illus., tables, 1967.

The average discharge of Waiakea Pond on June 27–28, 1965, was computed to be 111 mgd and represents the total discharge of numerous springs feeding the pond. The rate of outflow from the pond equalled the average discharge when the pond stage had risen about 0.01 ft from each of the two low-tide stages. At the lower high tide, the outflow rate equalled the average discharge when the pond stage was at its peak. The weighted average chloride concentration of the outflow, 609 ppm, was much higher than can be accounted for by mixing of 110 million gallons of spring water containing 7 ppm of chloride and 3.6 million gallons of tidal inflow water whose maximum chloride concentration was 4,500 ppm.—Author's abstract

04837 **Hodges, E. B.** (and others). Annual report on ground water in Arizona, spring 1965 to spring 1966: Arizona Land Dept. Water-Resources Rept. 32, 61 p., illus., 1967.

Nearly two-thirds of the water supply for the State of Arizona is obtained from ground water, the chief use of which is for irrigation of crops, especially in the

highly beveloped areas of the Basin and Range lowlands province of southern Arizona. The largest agricultural areas—the Salt River Valley and the lower Santa Cruz basin—account for more than 60 percent of the total withdrawn and have the greatest water-level declines. The ground-water conditions in selected basins and areas are discussed on the basis of hydrologic data collected from spring 1965 to spring 1966. There have been large water-level declines also in the Stewart and Kansas Settlement areas of the Willcox basin, the Bowie and San Simon areas in the San Simon basin, and the Avra Valley west of Tucson.—GDC

Hoekstra, Pieter. *See* Low, Philip F. 04396

04588 **Hoering, Thomas C.** The organic geochemistry of Precambrian rocks, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 87–111, illus., tables, 1967.

Evidence of types of chemical processes that were used by ancient organisms is being found. Carbon isotope studies indicate that photosynthesis was similar to that today. Evidence from porphyrins and isoprenoid hydrocarbons points to the use of chlorophyl-like pigments. Normal alkanes in rocks and acids from the oxidation of kerogen show that lipids were synthesized by presently used pathways. Kerogen pyrolysis indicates that the organic matter preserved in old sediments has many of the same constituents as more recent material. Results show that by 2,000 million years ago, life had already evolved to a complex state. Evidence for the period before this is fragmentary because of alteration. Further search through Precambrian rocks for larger amounts of organic matter is needed. Other avenues of approach are suggested.—ESL

Hohn, Matthew H. *See* Colingsworth, Roscoe F. 04886

04457 **Holister, G. S.** Determination of the mechanical properties of rock *in situ*: Internat. Jour. Rock Mechanics and Mining Sci., v. 4, no. 4, p. 437–448, illus., table, 1967.

It is suggested that an *in situ* testing technique to determine the shear modulus of a cohesive, non-fissured rock can be devised by measuring the elastic deformation in the vicinity of a pressurized hole in the rock. A laboratory simulation of the proposed field technique is described in which tests were made on blocks of sandstone and marble loaded biaxially. The theoretical stress distribution around the pressurized hole was compared with the elastic deformation demonstrated by a photoelastic coating surrounding the hole. The results appear to indicate that the method would be feasible in the field and that it could form a useful adjunct to the determination of residual stress by borehole stress-relief methods.—Author's abstract

04458 **Holister, G. S.** The moiré technique applied to the study of non-elastic materials: Internat. Jour. Rock Mechanics and Mining Sci., v. 4, no. 4, p. 383–394, illus., 1967.

The moiré method is described as an aid to the study of the deformation of plastic materials. Details are given of techniques designed to facilitate the measurement of surface strain over relatively large areas of a cohesive soil or clay, and to determine deformation in a three-dimensional model of a clay.—Author's abstract

Honjo, Susumu. *See* Fischer, Alfred G. 04876

04462 **Honkala, Fred S.** The Phosphoria Formation in Montana, *in* Centennial basin of southwest Montana—Montana Geol. Soc., 18th Ann. Field Conf. 1967, Guidebook: [Billings, Mont.] Montana Geol. Soc., p. 21–30, illus., 1967.

This is fundamentally a summary of previously-published work. The interfingering of the tongues of the Park City and Phosphoria Formations is described. The former, 500 feet thick, has two carbonate members with the Meade Peak Phosphatic Shale Member of the Phosphoria intercalated. The Phosphoria, 250–450 feet in Montana, has the Meade Peak at its base in turn overlain by the Rex Chert, cherty shale, and the Retort Phosphatic Shale Members. The Shedhorn Sandstone is a

shelf facies, and other local facies are also present. All the commercial phosphate comes from the Phosphoria Formation in Montana; most is mined underground. There are 1.2 billion tons in reserve south of Butte and 68 million tons to the north. Problems of mining are described also.—HRC

04508 **Hood, William C.; Custer, Richard L. P.** Use of the Frantz isodynamic separator for semiquantitative analysis of iron in trioctahedral micas [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 177, 1967.

Hooker, Verne E. *See* Becker, Robert M. 04733

04870 **Hopson, James A.** Comments on the competitive inferiority of the multituberculates: Systematic Zoology, v. 16, no. 4, p. 352–355, 1967.

Van Valen and Sloan (ibid., v. 15, p. 261–278, 1966) have presented convincing evidence that the extinction of the multituberculates was the result of unsuccessful competition with condylarths, primates, and rodents in the Paleocene and Eocene, but the question of why they were inferior is not satisfactorily answered. Hopson suggests that Cretaceous and earliest Paleocene multituberculates remained significantly below the eutherian level of advancement in nearly all areas of their biology, and their continued survival and even diversification, depended principally on the fact that they were still the only mammalian occupants of the herbivorous adaptive zone. When the placentals invaded this zone in the Paleocene, the multituberculates lacked the biological resources to successfully compete with them, and were crowded into extinction.—ESL

Hounslow, A. W. *See* Chao, G. Y. 04633

04680 **Hubert, Claude.** Tectonics of part of the Sillery Formation in the Chaudière-Matapédia segment of the Québec Appalachians, *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 33–40, illus., table, 1967.

On the south shore of the St. Lawrence, between Montmagny and Rivière-du-Loup, the Cambro-Ordovician Sillery Formation constitutes a complex synclinorium which extends to and flanks the northwestern side of the Sutton anticlinorium. The synclinorium is broken by several *en echelon* reverse faults and is composed of imbricated wedges and blocks, brought into contact from different sites of origin across the basin of deposition.—Author's abstract

04429 **Hughes, Gilbert H.** Analysis of the water-level fluctuations of Lake Jackson near Tallahassee, Florida: Florida Board Conserv. Div. Geology Rept. Inv. 48, 25 p., illus., tables, 1967.

The present high level of the lake is due to an unusual number of successive years of greater-than-average rainfall. Total rainfall from 1963–65 exceeded that for any 3-year period since 1885, while the drought during 1954–56 was the most extreme that occurred in the same period. Rainfall on the lake and surface-water inflow after storms are the main factors causing the rise, rainfall being predominant. Ground-water inflow apparently contributes appreciably to the lake during years of greater-than-average rainfall, and retards decline due to evaporation and ground-water outflow during the interval between storms. The lake level can be stabilized, but facilities must be designed to remove water during unusually great rainfall and to return water during years of less than average rain.—ESL

Hughes, Jerry L. *See* Eakin, Thomas E. 04395

04489 **Huh, Oscar Karl.** The Mississippian System across the Wasatch line, east central Idaho, extreme southwestern Montana, *in* Centennial basin of southwest Montana—Montana Geol. Soc., 18th Ann. Field Conf. 1967, Guidebook: [Billings, Mont.] Montana Geol. Soc., p. 31–62, illus., 1967.

In Idaho, west of the Wasatch Line, above the Milligen Formation, new Mississippian formations are recognized in the White Knob Group; they are, from bottom to top: Middle Canyon Limestone, Scott Peak Limestone, South Creek Formation, and Surrett Canyon Formation. Each is described, the total thickness

being about 4,000 feet. Coral zones, E, F, and K, are recognized and the rocks are correlated to post-Madison Group rocks on the Montana craton. Each unit is related to a tectonic event, primarily by sedimentary textures. The Idaho rocks were deposited in an actively subsiding basin which was bathymetrically distinct from the Montana craton. Quartz silt zones are used as time-parallel markers to unravel the complex facies across the hinge.—HRC

04328 **Hunkins, Kenneth; Kutschale, Henry.** Quaternary sedimentation in the Arctic Ocean, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 89–94, illus., 1967.

A distinct boundary between sediment types at a depth of 10 cm in cores from Alpha Rise represents the most recent change in pelagic deposition and must reflect climatic change. Sediment above 10 cm is brown foraminiferal lutite mixed with ice-rafted sand and pebbles; foraminifers from a zone between 7 and 10 cm have been C-14 dated as 25,000 and 30,000 yr B.P., and the 10 cm boundary itself as 70,000 yr B.P. by a uranium series method. If these dates are accepted, a low sedimentation rate of 1 1/2 to 3 mm/1000 yr is indicated for Alpha Rise, and for the whole Arctic Ocean if pelagic sedimentation has been uniform. Cores from the Canada Abyssal Plain are turbidity-current deposits, with a top 3-mm layer, similar to the Alpha Rise upper layer; foraminifers in it have been C-14 dated as 700 yr B.P. It is concluded that pelagic sedimentation has continued unchanged in the Arctic Ocean for the past 70,000 years.—VMJ

04521 **Hurley, P. M.** Rb^{87}-Sr^{87} relationships in the differentiation of the mantle, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 372–375, illus., table, 1967.

The Sr-87/Sr-86 ratio before rubidium began to decay, at the beginning of Earth history, is calculated. Any increase in Sr-87 must be radiogenic and can be calculated. The ratio is determined for various materials coming to the surface from the mantle; differing concentrations are explained. The minor elements are differentiated more easily in the outward-expanding fluid phase so that the level of their enrichment may indicate the extent that the fluid phase has "swept out" the solid phase in the mantle below. Oceanic basalts come from either deeper or less differentiated zones than do continental basalts whose ratio is high. Alpine-type ultramafics have higher ratios than oceanic basalts and tholeiites, and still higher than continental basalts at the time of emplacement. Explanations are wanting.—HRC

04305 **Hurr, R. Theodore.** Reply [to discussion of "A new approach for estimating transmissibility from specific capacity" (1966) by T. N. Narasimhan, 1967]: Water Resources Research, v. 3, no. 4, p. 1095, 1967.

Hurr agrees that the figure presented by Narasimhan [ibid., p. 1093–1095] provides a more rapid means of computing Q/S or T, when S is known, but it does not provide for solving certain problems. He still believes that his curves [ibid., v. 2, no. 4, p. 657–664, 1966] can be used in many different, geologically similar, aquifers.—ESL

04771 **Ingle, James Chesney, Jr.** Facies variation and the Miocene–Pliocene boundary in southern California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 942B, 1967.

04684 **Innes, M. J. S.; Argun-Weston, A.** Gravity measurements in Appalachia and their structural implications, *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 69–83, illus., 1967.

The main features of the gravitational field in the Appalachian regions of Canada are examined, using crustal models, in the light of surface geology and tectonic history. A marked gravity high over the Sutton–Green Mountain anticlinorium, and an adjacent gravity low to the northwest cannot be explained entirely by surface geology; deep-seated sources are necessary. These major gravity trends which mark the boundary between Appalachia and the Shield extend south to Alabama and northeast to Newfoundland. Statistical analyses show that Bouguer and free-air

anomalies are 30 mgal greater over the Appalachians, undercompensated by 20 mgal, than over the adjoining Precambrian Shield. Gravity results are consistent with the higher seismic velocities indicating a denser crust underlying Appalachia.—*from* Authors' abstract

04501 **Irvine, T. N.; Smith, C. H.** The ultramafic rocks of the Muskox intrusion, Northwest Territories, Canada, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 38–49, illus., 1967.

The intrusion, east of Bear Lake and south of Coppermine, is in a basement complex having K–Ar dates of 1,700 to 1,900 m.y. The cross section of the intrusion is funnel-shaped, and has been dated by K–Ar at 1,155–1,245 m.y. The intrusion is layered. The ultramafic layers are peridotite–orthopyroxene–websterite, dunite–olivine clinopyroxenite–olivine gabbro, with cyclic units within layers. The K-value for Ni lies between 10 and 15. Twenty-five cycles can be identified, of which 18 comprise two or more phase layers and seven are subdivisions of dunite layers. Evidence is presented to show that more magma was put into the system after crystallization had already begun.—HRC

04537 **Irvine, T. N.** The Duke Island Ultramafic Complex, southeastern Alaska, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 84–97, illus., table, 1967.

The Duke Island complex overlies gabbro; it is a result of at least two intrusions of liquid, forcibly emplaced and crystallized *in situ*. Crystal fractionization and gravity settling are dominant. Folding accompanied intrusion and also affects the present surface. Intercumulus processes of reaction and recrystallization have affected the texture, and pyroxene-rich rocks are locally replaced by secondary dunite. The small-scale rhythmic gravitational layering indicates that a rather violent physical activity in the magma bodies is both conducive to, and necessary for, the formation of such layering.—HRC

Jackson, Everett D. *See* Page, Norman J. 04370

04500 **Jackson, Everett D.** Ultramafic cumulates in the Stillwater, Great Dyke, and Bushveld intrusions, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 20–38, tables, 1967.

The ultramafic zones in the three units are similar in stratigraphic position, mineralogy, texture, mineral associations, and internal structure. The rocks are simple cumulates in which the cumulate crystals and postcumulus material can be distinguished readily. Differences are due to different primary magmas. The layers in the ultramafic zones are predominantly cumulates of one settled mineral which are disposed for the most part in isomodal layers with phase contacts. The Stillwater Complex is practically identical with the Great Dyke ultramafic zones. Vertical variations in mineral composition in all three zones are intricate and only partially known.—HRC

04795 **Jahanbagloo, Iraj C.** Pt. 1, The crystal structure of a hexagonal Al-serpentine; Pt. 2, Calculated X-ray powder patterns of minerals [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 942B–943B, 1967.

04539 **Jahns, Richard H.** Serpentinites of the Roxbury District, Vermont, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 137–160, illus., tables, 1967.

The district is underlain by greenstone and other metamorphic rocks of probable Ordovician age. The serpentinite bodies are conformable to regional trends, and are in a narrow belt three miles long. Details of their internal structures, lithologic zoning, and petrographic features are given. They are basic lavas in Paleozoic sedimentary rocks metamorphosed in the eugeosyncline. The original magma may have been ultrabasic from subcrustal material, or the rocks may be differentiates from a basic magma. The steatite and associates are unrelated to earlier serpentinization, and are due to carbon-dioxide metasomatism and metamorphic differentiation.—HRC

04732 **James, Clifford H.** The use of the terms "primary" and "secondary" dispersion in geochemical prospecting: Econ. Geology, v. 62, no. 7, p. 997–999, 1967.

It is suggested that "primary dispersion pattern" be reserved for distribution of elements in the unweathered rock surrounding an ore body, regardless of origin. "Secondary dispersion patterns" reflect redistribution of primary patterns within the zone of surface oxidation.—WSW

Jensen, O. G. *See* Currie, R. G. 04665

04651 **Jepsen, Glenn L.** Time, strata, and fossils—Comments and recommendations, *in* Time and stratigraphy in the evolution of man—NAS–NRC, Div. Earth Sci., Symposium, Washington, D. C., 1965: Natl. Acad. Sci.–Natl. Research Council Pub. 1469, p. 88–97, 1967.

Jepsen summarizes and comments upon the problems and ideas presented in the papers of the symposium. He recommends that for perceiving and naming species, anthropologists should practice the relatively objective systems and codified rules that competent specialists use for the classification of nonhominid groups, in order to end the chaotic state of anthropological nomenclature. It is also recommended that much more field research be done to find more ancient hominid fossils to fill in the great gaps in knowledge of the hominids.—MST

04546 **Jerome, S. E.** Geologic variations of geophysical significance in porphyry copper deposits: Western Miner, v. 40, no. 10, p. 28–36, illus., 1967.

Where porphyry copper deposits are in intermediate rocks that are intrusive into carbonate sediments, hydrothermal effects are well developed in the intrusive and to a lesser extent in wall rocks. Where the deposit is in intermediate intrusives in non-carbonate rocks satellite, orebodies are rare. Different types of cover materials are evaluated. These variations create problems in exploration for copper porphyrys by geophysical methods. Generalized geophysical expressions are illustrated for magnetic, gravity, and various electrical methods.—ARK

Jobin, Daniel A. *See* Albee, Howard F. 04302

Johnson, J. G. *See* Boucot, A. J. 04472

04355 **Johnson, Ross B.** Rock streams on Mount Mestas, Sangre de Cristo Mountains, southern Colorado, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575–D, p. D217–D220, illus., 1967.

Rock streams on the west side of Mount Mestas are composed of imbricated tabular fragments of brittle microgranite and microsyenite. One rock stream has an ice matrix. The ice apparently permits flowage of the rock stream in a manner similar to that of an alpine valley glacier. Continuing movement of the rock stream is revealed by bending of pines and the tilting and partial burial of young aspens growing at its toe.—Author's abstract

Johnston, R. *See* Drever, H. I. 04534

Johnston, R. *See* Drever, H. I. 04536

04664 **Jones, F. W.; Geldart, L. P.** Vertical telluric currents: Earth and Planetary Sci. Letters, v. 2, no. 1, p. 69–74, illus., 1967.

Vertical and horizontal components of earth currents in the frequency range 0.0012–0.12 Hz have been recorded simultaneously at a base station and a mobile station near Montreal, Canada. Preliminary results indicate that: (1) the vertical and horizontal components at the same location are comparable in amplitude and frequency, (2) the vertical components at two locations as much as 160 km apart are comparable.—Authors' abstract

04667 **Jones, F. W.; Geldart, L. P.** Vertical telluric currents at separated locations: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 174–176, illus., 1967.

The vertical component of earth current has been recorded simultaneously at a location near the ocean and a location inland. The separation distance between locations was approximately 800 km. Interference at one location hampered measurement of daytime activity. Nighttime activity has been compared and is found to be related at the two locations. The amplitude of the disturbances near the sea appears to be considerably attenuated with respect to the amplitude inland.—Authors' abstract

04604 **Jorgensen, Per.** Density, conductance and infrared studies of clay–water systems [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 430B, 1967.

Jorgeson, Eric. *See* Kier, Jerry. 04512

04570 **Juo, Anthony Shiang-Ru.** Chemical and physical factors affecting the relative availability of inorganic phosphorus in soils [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 765B, 1967.

04504 **Justus, Philip S.** Evidence for volcanism or shallow intrusion in the Triassic Pekin Formation of the Deep River basin, North Carolina [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 176–177, 1967.

04514 **Justus, Philip S.** Occurrence of chlorite±actinolite±talc schist along the Brevard zone in Wilkes and Caldwell Counties, North Carolina [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 178, 1967.

04632 **Kanehira, K.; Bachinski, D.** Framboidal pyrite and concentric textures in ores of the Tilt Cove mine, northeastern Newfoundland: Canadian Mineralogist, v. 9, pt. 1, p. 124–128, illus., 1967.

Framboidal pyrite and concentric textures of pyrite, chalcopyrite, and sphalerite suggest deposition under near surface conditions with little post-depositional metamorphism.—EHR

Kansara, Mohan. *See* Taylor, Denis. 04460

Kapp, Ronald O. *See* Gilliam, Jeanne A. 04858

Karlstrom, Thor N. V. *See* Foster, Helen. 04751

04421 **Kaufman, Matthew I.** Hydrologic effects of ground-water pumpage in the Peace and Alafia River basins, Florida, 1934–1965: Florida Board Conserv. Div. Geology Rept. Inv. 49, 32 p., illus., 1967.

Increased use of water from the Floridan aquifer in the area east-southeast of Tampa is causing progressive decline of artesian water levels. In the phosphate area of Polk County, levels have lowered more than 50 feet. The area of decline now reaches the ridge and sinkhole lake region to the northeast and may be responsible in part for lowered lake levels. Other effects of the lowered artesian level are: pumping difficulties, reversal of hydrologic conditions along the Peace River between Bartow and Ft. Meade from one of discharge from the aquifer in 1934 to one of potential recharge in 1965, opportunity for upward migration of the saline–fresh water interface, and collapse of the subsurface resulting in sinkholes. A quantitative evaluation of the Floridan aquifer in the Peace and Alafia River basins, especially in the heavily pumped areas, is needed.—*from* Author's abstract

04772 **Keighin, Charles William.** Phase relations in the system Ag–Sb–S [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 943B, 1967.

04856 **Kellum, L. B.; Wright, R. P.** Geology of the southern part of the Sierra de Tlohualilo, Coahuila, Mexico: Michigan Acad. Sci., Arts and Letters Papers 1966. v. 52, p. 151–161, illus., geol. map, 1967.

The southern Sierra de Tlahualilo forms the western part of the San Francisco quadrangle. This area of 300 sq mi was mapped in 1965; the geologic map is to be published by the Instituto de Geología of the University of Mexico. Oldest

rocks exposed are Permian, and are overlain by the Cretaceous Acatita Formation, exposed in several windows. The overlying Aurora Limestone forms an apron around the southern margin and caps the ridges between drainage basins. Remnants of the Indidura Formaion, Upper Cretaceous, are preserved in isolated patches. Isolated gravel hills are regarded as remnants of stream channel deposits. Two areas of volcanic rocks occur in the northwest and southeast. The Sierra is a broad, gentle, asymmetric anticline; its relation to four domes along the west side is unknown.—ESL

04432 **Kelly, Allan O.** Continental drift—Is it a cometary impact phenomenon?: Carlsbad, Calif., privately printed, 100 p., illus., revised 1967; originally published 1963.

Motive power for continental drift is considered by some to have come from within the Earth, and by others from without. The convection theory and related questions are reviewed. Extra-terrestrial forces are gravitational disruption and meteoritic or cometary impact, the second being more logical. A cometary train striking the Pacific side of the Earth is suggested. These impacts not only melted that side, but cracked open the crust on the other side, allowing continental masses and smaller islands to drift toward the area of impact. Features in and around the Pacific are ascribed to this cataclysm. Evidence of drift on the Moon and formation of lava in craters by impact, the meteoritic origin of the Gulf of St. Lawrence and the Hudson Bay arc, astronomical considerations of collision-drift, and the dynamics of continental drift are discussed.—ESL

04845 **Kern, Raymond; Weisbrod, Alain.** Thermodynamics for geologists (translated from French by Duncan McKie): San Francisco, Calif., Freeman, Cooper and Co., 304 p., illus., tables, 1967; originally published *as* Thermodynamique de base pour minéralogists, pétrographes et géologues, 1964.

This volume gives a unique geologic slant to basic thermodynamics, and demonstrates in detail some applications, particularly in rock mineral assemblages with problems involving phase changes. Taken from scattered literature of the past 20 years, original conclusions often are extended and errors corrected. Simple structural models, as used by Lapparent (1941) for interpreting granitic minerals, replace theoretical speculation. Thermodynamic equations established for some experiments can be extrapolated to predict reactions more difficult to achieve. The material has been taught at the Université de Nancy and Cambridge University.—GDC

04638 **Kesler, Stephen E.** Skarn and ore formation at the Meme copper deposit, Haiti [abs.]: Econ. Geology, v. 62, no. 6, p. 872, 1967.

04336 **Ketner, Keith B.** West Coast region, Chap. K *in* Paleotectonic investigations of the Permian System in the United States: U.S. Geol. Survey Prof. Paper 515, p. 225–238, tables, 1967.

During Permian time the West Coast region was divided into three paleotectonic parts—an eastern miogeosyncline, a western eugeosyncline, and an intervening tectonic land (Antler orogenic belt) with bordering aprons of detrital sediment. The character of the sparsely exposed Permian rocks of this area suggests that it was covered by a sea which received sediments from emergent lands and from volcanoes, either subaerial or submarine. These rocks crop out along a curved belt that may define the configuration of the former eugeosyncline.—MST

04739 **Kiefer, Ralph W.** Terrain analysis for metropolitan fringe area planning: Am. Soc. Civil Engineers Proc., v. 93, paper 5649, Jour. Urban Plan. and Devel. Div., no. UP4, p. 119–139, illus., tables, 1967.

A method for mapping physical characteristics of land, and for applying this information to evaluation of suitability of land in metropolitan fringe areas to urban development is presented. It is proposed that land use suitability maps be prepared for planning areas; these indicate relative land use suitability of terrain units by rating units as optimum, satisfactory, marginal, or unsatisfactory for various land

uses. Ratings are based primarily on the topography, soil, drainage, and depth to bedrock characteristics of land areas. Land use suitability maps should be used as a planning tool in conjunction with evaluation of other social, economic, political, and environmental factors that shape urban development.—*from* Author's abstract

04512 **Kier, Jerry; Dill, Charles; Jorgeson, Eric; Turner, William.** The Recent–relict sediment boundary on the continental shelf off the southeastern United States [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 179, 1967.

04773 **Kilmer, Frank Hale.** Cretaceous and Cenozoic stratigraphy and paleontology, El Rosario area, Baja California, Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 943B, 1967.

04446 **Kimura, Hubert S.; Swindale, L. D.** A discriminant function using zirconium and nickel for parent rocks of strongly weathered Hawaiian soils: Soil Sci., v. 104, no. 1, p. 69–76, illus., 1967.

A discriminant function of the form Zr–1.44 Ni has been developed to distinguish between parent rocks of deeply weathered Hawaiian soils. It was found that total Zr in the solum increased with increased weathering; the total nickel in the solum increased up to the upper limit of the oxisols and then decreased progressively in ultisols and a spodosol. Although Zr and Ni have different distribution patterns throughout the soils, the discriminant function successfully differentiated andesite-derived soils from basalt-derived soils for every horizon analyzed.—JWH

04728 **King, E. G.; Barany, R.; Weller, W. W.; Pankratz, L. B.** Thermodynamic properties of forsterite and serpentine: U.S. Bur. Mines Rept. Inv. 6962, 19 p., illus., tables, 1967.

The Bureau of Mines made experimental determinations of the heats of formation of forsterite and chrysotile at 298.15°K. The heat capacities of two polymorphs of serpentine, chrysotile and antigorite, were measured over the temperature range from 50° to 298°K and the entropies at 298.15°K were evaluated. The heat content of antigorite above 298.15°K was measured to 850°K. These thermochemical data were combined with other pertinent data to give heat and free energy of formation values at high temperatures. Free energy values are given for the reaction, forsterite + water = brucite + serpentine at different temperatures and pressures.—Authors' abstract

04885 **King, James E.** Modern pollen rain and fossil pollen in soils in the Sandia Mountains, New Mexico: Michigan Acad. Sci., Arts and Letters Papers 1966, v. 52, p. 31–41, illus., 1967.

Pleistocene climatic changes displaced plant communities vertically in the Southwest, but there have been conflicting conclusions as to the amount of displacement. In this study, modern pollen rain for each forest association on the east slope of the Sandia Mts. was determined and then compared with fossil pollen profiles at four elevations between 10,000 and 7,300 feet. Forest associations are from highest to lowest: spruce–fir, mixed conifer, ponderosa pine–Douglas fir, and pinyon–juniper. The pollen of *Picea engelmanni*, the only spruce in the mountains, and *Abies*, dominating mixed conifers, are not subject to wind-drift. In all fossil pollen profiles, *Picea* increases with depth and *Abies* decreases. At 7,300 feet *Picea* increased from zero at the surface to over seven percent at the bottom. The spruce–fir is now limited to above 10,000 feet, so at least 2,700 feet of displacement has taken place.—ESL

Kirsten, T. *See* Funkhouser, J. 04668

Kistler, Ronald W. *See* Willden, Ronald. 04375

04068 **Knauf, J. William.** New system for viewing mapping photographs, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575–D, p. D284–

D288, illus., 1967.

The U.S. Geological Survey has developed an image-separation system for viewing either black-and-white or color stereoscopic models on projection-type stereoplotters that does not require the use of filters. Known as the StereoImage Alternator (SIA), the system consists of rotating cylindrical shutters in both the projection field and the viewing field, synchronized so that each eye can see only the image from the corresponding (left or right) projector. Although the concept of alternating images for stereoscopic viewing is not new, the system by which they are obtained is both unique and practical.—Author's abstract

04505 **Koch, Henning F.** Probable flow-structures of the diabase of the Durham Triassic Basin, N. C. [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 176, 1967.

04747 **Koteff, Carl.** Summary report on the geology and mineral resources of the Monomoy National Wildlife Refuge, Barnstable County, Massachusetts: U.S. Geol. Survey Bull. 1260-D, p. D1-D4, illus., 1967.

Monomoy National Wildlife Refuge occupies Monomoy Island and a small part of Morris Island at the southeast corner of Cape Cod. Most of the refuge is underlain by beach and dune sand derived by wave action and transported southward by shore currents. Wind action on the beach deposits has piled a line of coastal dunes along the central part of Monomoy Island. The sands are underlain by glacial drift, which probably is several hundred feet thick. Far below sea level, the drift lies on a basement of crystalline rocks. The Monomoy Refuge has no known mineral resources other than the sands from which the islands are made. Considering the abundance of sand in the Cape Cod area, the sand of the refuge is of low economic value.—Author's abstract

04420 **Krauskopf, Konrad B.; Beiser, Arthur.** The physical universe (2d edition): New York, McGraw-Hill Book Co., 680 p., illus., tables, 1967; originally published 1960.

Chapter headings of this edition are: motion; force and motion; gravitation; energy and momentum; fluids and waves; kinetic theory of matter; electricity; currents and magnetic fields; light; basic chemistry; atomic nucleus; theory of the atom; periodic law; crystals, ions, and solutions; chemical reactions; organic chemistry; earth materials; atmosphere and hydrosphere; changing crust; within the Earth; history of Earth; Sun and its family; stars; and universe. Each chapter concludes with a set of questions and problems.—ESL

04426 **Krinitzsky, E. L.; Turnbull, W. J.** Loess deposits of Mississippi: Geol. Soc. America Spec. Paper 94, 64 p., illus., tables, 1967.

Mississippi loess was developed by eolian transport from braided-stream deposits in the Mississippi River alluvial valley during late Pleistocene and early Recent time. Stratigraphically, it is divided into the Vicksburg loess, a basal transition zone, and a pre-Vicksburg loess. Where these sheets thin and are weathered throughout, the entire section is called Mississippi brown loam. The calcareous Vicksburg loess is bedded as a result of periods of quiescence, and contains carbonate tubules and concretions formed by roots. Unique strength properties of the loess result from its origin and bonding of silt grains by cementing materials. Infiltration of rain is such that loess may remain dry a few feet below the surface. It makes a satisfactory foundation and construction material if proper design measures are taken, and is stable on properly designed slopes. It has less sand, and is somewhat denser than other loess.—ESL

04329 **Ku, Teh-Lung; Broecker, Wallace S.** Rates of sedimentation in the Arctic Ocean, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 95-104, illus., tables, 1967.

The sedimentation rate in the Arctic deep-sea over the last 150,000 years has undergone no significant changes. Based on both radiocarbon and uranium series isotope analyses, the deposition rate is estimated to be about 0.2 cm/1000 years. These findings imply that: (1) the observed variations in the Foraminifera abundance

in most Arctic cores reflect changes in the biological productivity; (2) the Arctic Foraminifera abundance curves cannot be simply correlated with those observed in the Atlantic deep-sea cores; and (3) the Arctic Ocean has not been open during the last 150,000 years.—Authors' abstract

04599 **Kullerud, G.** Sulfide studies, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 286–321, illus., 1967.

Bearing in mind the importance of low-temperature phase relations, the most important binary system, Fe-S, is considered first, then the phase relations in the copper-iron-sulfur and iron-nickel-sulfur systems. Finally reactions between sulfides and certain silicates, carbonates, and oxides are described, and the possible importance of sulfurization as an ore-forming process is discussed.—ESL

Kulp, J. Laurence. *See* McDowell, Fred W. 04710

Kuno, Hisashi. *See* Forbes, Robert B. 04517

Kuroda, P. K. *See* Clark, R. S. 04341

04568 **Kutina, Jan.** International Association on the Genesis of Ore Deposits—Symposium on ore genesis at St. Andrews, Scotland: Econ. Geology, v. 62, no. 8, p. 1103–1107, 1967.

Abstracts of the 53 scientific papers are published in the Inst. Mining and Metallurgy Transactions, Section B, v. 76, Bull. 732, 1967.—WSW

Kutschale, Henry. *See* Hunkins, Kenneth. 04328

LaCoste, L. J. B. *See* McCulloh, T. H. 04351

04713 **LaCoste, Lucien J. B.** Measurement of gravity at sea and in the air: Rev. Geophysics, v. 5, no. 4, p. 477–526, illus., tables, 1967.

In gravity measurement at sea, effects of vertical accelerations show that gravimeter nonlinearities cause errors proportional to the square of vertical acceleration. In horizontal accelerations, similarities and differences exist between gimbal supported and stabilized platform gravimeters. Optimization of parameters of a stabilized reference can reduce gravimeter errors by two or more orders of magnitude. A method for correcting for inadequate period of a stabilized reference is given, the Schuler-tuned stabilized platform is described, and theory of inherent type cross coupling and examples of imperfection type cross coupling are given. Theory and details of construction are given for the LaCoste and Romberg gravimeter and stabilized platform; tests on L and R air-sea gravimeters indicate that attainable accuracy is appreciably better than 1 mgal.—*from* Author's abstract

04366 **Lai, Chintu.** Computation of transient flows in rivers and estuaries by the multiple-reach method of characteristics, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D273–D280, illus., 1967.

In order to compute transient flows in long reaches of rivers or estuaries having variable cross sections and other variable factors, a computer program previously developed to solve flows in a simple uniform reach by the method of characteristics has been extended. A long reach is divided into *m* subreaches, each of which may be considered to have uniform geometry as well as other constant factors. The basic method of characteristics is applied to each subreach, and additional boundary conditions are imposed at each junction between subreaches. The graphical display of digital computer output from sample computations indicates that the method developed is suitable for analyzing complex transient flows in long waterways.—Author's abstract

04831 **Lambert, T. W.** Availability of ground water in parts of the New Madrid SE, Hubbard Lake, and Bondurant quadrangles, Jackson Purchase region, Kentucky-Tennessee: U.S. Geol. Survey Hydrol. Inv. Atlas HA-178, 2 sheets, scale 1:24,000,

sections, text, 1967.

The most important aquifers in the southwestern part of Fulton County are Eocene alluvial deposits and sands; less important are deeper Cretaceous sediments and Paleozoic limestones and dolomites. Depth to main zone of saturation in Quaternary alluvium ranges from a few feet to more than 25 feet, and maximum thickness may be 250 feet; large yields can be obtained from properly designed wells; three important Eocene aquifers are available for development by industry. Quality of water from alluvium in the main zone is good for most uses, while that from the Eocene is excellent.—MCM

Landrum, J. Roger. *See* Smith, James W. 04393

Lange, Ian M. *See* Cheney, Eric S. 04627

04542 **Lapham, Davis M.** The tectonic history of multiply deformed serpentinite in the Piedmont of Pennsylvania, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 174–183, illus., 1967.

The serpentinite occurs intruded into the Peters Creek Formation of the Glenarm Series in Chester and Lancaster Counties. Macrostructures (cleavage, joints, faults, fold axes, banding) and microstructures (lineations, foliations, small banding) are studied in the serpentinite and in the enclosing country rock. Three intervals of deformation are recognized in each, and details suggest that the emplacement of the original ultrabasic was contemporaneous with or before the first deformation and before serpentinization, which came later. Dating suggests emplacement at least 460 m.y. ago under a regional crustal deformational stress which had characteristics of flow deformation, now visually represented by the strike lineament of the massif.—HRC

04419 **Larson, Allen C.** Inclusion of secondary extinction in least-squares calculations: Acta Cryst., v. 23, pt. 4, p. 664–665, table, 1967.

A procedure for including secondary extinction as a parameter in crystal structure least-squares analysis is described and the effect of its use on the data for chrysoberyl is given.—Author's abstract

Laudelout, Henri. *See* Bladel, Robert Van. 04448

04774 **Laury, Robert Lee.** Sedimentology of the Pleasantview Sandstone, southern Iowa and western Illinois [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 944B, 1967.

04693 **LaValle, Placido.** Geographic processes and the analysis of karst depression distribution within homogeneous limestone regions [abs.]: Assoc. Am. Geographers Annals, v. 57, no. 4, p. 794, 1967.

04308 **Lee, Kenneth L.; Seed, H. Bolton.** Drained strength characteristics of sands: Am. Soc. Civil Engineers Proc., v. 93, paper 5561, Jour. Soil Mechanics and Found Div., no. SM6, p. 117–141, illus., 1967.

Drained triaxial compression tests with volume change measurements were performed on samples of two sands at confining pressures up to 140 kg per sq cm to clarify components contributing to shearing strength and to determine strength characteristics under essentially constant volume conditions. Three components of shearing strength were identified: sliding friction, dilation, and particle crushing and rearranging. The study was extended to determine envelope of failure when shear deformation occurs at essentially constant volume by testing at the appropriate critical confining pressure corresponding to that density. The constant volume envelope of failure determined by such tests was shown to be in reasonably good agreement with that obtained for drained tests if dilatancy effects are deducted using the Taylor–Bishop or Rowe dilatancy formulas.—*from* Authors' abstract

04321 **Lee, Kenneth L.; Seed, H. Bolton; Dunlop, Peter.** Effect of moisture on the strength of a clean sand: Am. Soc. Civil Engineers Proc., v. 93, paper 5551, Jour.

Soil Mechanics and Found Div., no. SM6, p. 17–39, illus., tables, 1967.

Fully-drained triaxial compression tests on samples of clean river sand (Antioch [Calif.] sand) indicated that the soil was considerably stronger in oven dry than in saturated state; strength of air dry sand was intermediate between these two. Decrease in strength with increasing moisture content was accompanied by decrease in dilatant volume change tendency and increase in particle crushing as samples were sheared. A few special sustained loading tests were performed on air dry and oven dry samples of this sand. Sustained loads were less than air dry strength, but greater than strength when saturated; both types failed almost immediately after water was introduced at the base. Microscopic analysis indicated that some sand particles appeared weathered and cracked, and some cracks may have contained thin films of clay. The peculiar water sensitive behavior of the sand was attributed to these cracks.—*from* Authors' abstract

04484 **Lenz, A. C.** *Thliborhynchia*, a new Lower Devonian rhynchonellid from Royal Creek, Yukon, Canada: Jour. Paleontology, v. 41, no. 5, p. 1188–1192, illus., 1967.

A new brachiopod genus *Thliborhynchia* (type species *T. julli* sp. nov.) is described from beds of late Siegenian age of Royal Creek, Yukon. *Thliborhynchia* is believed to have been derived from the *Machaeraria* stock during Gedinnian or early Siegenian time. It is separated from *Machaeraria* primarily by the possession of pronounced, pinched posterolateral slopes, and the sharp, predominantly undivided costae.—Author's abstract

Leussink, Hans. *See* Brauns, Josef. 04315

04662 **Lewis, John S.** A possible origin for sulfates and sulfur in meteorites: Earth and Planetary Sci. Letters, v. 2, no. 1, p. 29–32, table, 1967.

Two possible origins for the sulfur compounds found in the carbonaceous chondrites are investigated here: oxidation of troilite by dissolved oxygen, and oxidation of troilite by dilute hydrogen peroxide solution. HOOH oxidation is concluded to be a more acceptable explanation for the observed distribution of sulfur compounds than either O_2 oxidation or previously suggested processes.—Author's abstract

04746 **Lewis, Richard Q., Sr.** Geologic map of the Dubre quadrangle, southern Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-676, scale 1:24,000, sections, text, 1967.

Mineral resources of the Dubre quadrangle are petroleum and small amounts of natural gas and limestone. Significant production of petroleum from about 1900-1930, probably from Early and Middle Ordovician rocks, occurred from wells near Salt Lick Bend. About 30 years ago natural gas was produced from several wells for local use along Slate Creek valley; producing zone is not known. Limestone quarried from reef limestone in the Fort Payne Formation was used locally for several years prior to about 1935. Small deposits of chert gravel are worked along channels of larger creeks.—MCM

04560 **Lin, Hsi-che.** An investigation of the stability relations of $BaAl_2Si_2O_8$ (CELSIAN) in the system BaO-Al_2O_3-SiO_2 [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 1039B, 1967.

04407 **Lister, C. R. B.; Whetten, John T.; McKee, Bates.** Sonar reflection profiling on the Columbia River and in Lake Washington: Northwest Sci., v. 41, no. 4, p. 152–154, illus., 1967.

A new sound source that can be used in either saline or salt-free water and which operates on the principle of electromagnetic repulsion between moving coils was tried out in Bonneville Reservoir on the lower Columbia River, and on Lake Washington from Sand Point to Houghton. The reservoir profile shows sand-size sediment overlying flat basalt; the top of the sediment shows large sand waves. The Lake Washington profile indicates that the steep slope of the trough at the edge of the lake goes down 128 m below lake level. This surface, with substantial relief, is buried by a thick section of blue clay, which is overlain by a layer of limnic peat containing a 5 cm ash layer, dated as Mazama.—ESL

04567 **Losche, Craig Kendall.** Soil genesis and forest growth on steeply sloping landscapes of the southern Appalachians [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 765B–766B, 1967.

04396 **Low, Philip F.; Hoekstra, Pieter; Anderson, Duwayne M.** Some thermodynamic relationships for soils at or below the freezing point—[Pt.] 2, Effects of temperature and pressure on unfrozen soil water: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 222, pt. 2, 5 p., illus., table, 1967.

Thermodynamic methods are presented for calculating, from the water adsorption isotherms, the change in unfrozen water content of a partially frozen soil with temperature at a constant pressure or with pressure at a constant temperature. Then, using pertinent experimental data for Na–Wyoming bentonite, the increase in unfrozen water caused by a confining pressure of 100 atm is obtained as a function of temperature. Such information is shown to be relevant to the mechanical properties of frozen soils under stress.—Authors' summary

04860 **Macdonald, J. R.** The Maricopa Brea: Los Angeles County Mus. Nat. History Quart., v. 6, no. 2, p. 21–24, illus., 1967.

This is a popular account of work at the Maricopa Brea, a late Pleistocene deposit of fossil animals. Preliminary studies suggested it was an ancient water hole near the foot of the San Emigdio Range, Calif. The overburden is oil-permeated but this may be the result of dumping from a shallow well; the fossils are not impregnated. Hypotheses of the origin of the deposit and the classic feuds caused by some are examined. At present the asphalt appears to be a preservative, but not a trapping factor. Other hypotheses are natural deaths at the water hole, or entrapment in the mud. Collecting at the site is described.—ESL

04523 **MacGregor, I. D.** Mineralogy of model mantle compositions, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 382–393, illus., 1967.

Various studies indicate that the mantle is ultramafic and probably corresponds closely to a four-phase spinel or garnet peridotite in composition. The system CaO–MgO–Al_2O_3–SiO_2 has been used as an experimental model of the stability relationships of the different peridotite phase assemblages. For a variety of two-pyroxene peridotite compositions, the reactions governing the boundaries between the different assemblages occur at the same temperatures and pressures. Hence, phase changes in an ultramafic upper mantle are governed by a limited number of reactions. The relations of these reactions to the geothermal gradient is discussed. All-in-all, a two pyroxene peridotite is an adequate representation of the composition of the upper mantle.—HRC

04694 **Mackay, J. Ross.** The age of permafrost in the lower Mackenzie Valley, NWT [abs.]: Assoc. Am. Geographers Annals, v. 57, no. 4, p. 795, 1967.

04605 **Majlis, Muhammad Ali Kahn.** Some factors affecting the production and measurement of colors in montmorillonite and kaolinite clays and natural soils [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 431B–432B, 1967.

04726 **Maloney, Raymond P.** Investigations of the White Mountain mercury deposit, Kuskokwim River basin, Alaska: U.S. Bur. Mines Rept. Inv. 6892, 94 p., illus., tables, 1967.

Mercury deposits occur within a Paleozoic dolomitic limestone and shale sequence in a zone about 12,000 feet long and up to 1,500 feet wide parallel to the northeast-trending Farewell fault. Bedrock southeast of the fault is Cretaceous conglomerate and is not mineralized. The deposits consist of lenses and stringers containing calcite or dolomite and cinnabar in a limestone or dolomitic limestone host. An altered trachyte is associated with the mineralization at some deposits and geyserite was noted at others. Stream sediment samples from streams crossing the Farewell fault about 15 miles northeast of the White Mountain area contained traces of mercury, as did those draining the interfluvial area between the Tatlawiksuk and Cheeneetnuk Rivers about 15 miles southwest of the White Mountain area.—KFF

Mandarino, J. A. *See* Chao, G. Y. 04633

04436 **Manheim, Frank T.** Evidence for submarine discharge of water on the Atlantic continental slope of the southern United States, and suggestions for further search: New York Acad. Sci. Trans., ser. 2, v. 29, no. 7, p. 839–853, illus., 1967.

Fresh and brackish waters have been observed in drill holes on the floor of the Atlantic Ocean as far as 120 km from the coast of Florida. These data and observations on the Blake Plateau indicate that fresh and brackish water is discharging in the Florida–Hatteras slope regions. Discharge zones appear to be associated with probable outcrops and lightly covered exposures of Eocene strata, hosts for the Floridan aquifer on the continent. Local depressions in these outcrop areas may have formed first during the Pleistocene glacial maximum by a combination of sapping caused by submarine discharge and erosion by bottom currents. Electrical logging techniques offer possible methods for monitoring the changes in fluids both below and above the sea bottom. Most of the equipment needed to adapt such techniques to logging from a ship under way or a submersible is available commercially.—*from* Author's summary

Manheim, Frank T. *See* Schopf, Thomas J. M. 04471

04439 **Manning, Thomas G.** Government in science—The U.S. Geological Survey, 1867–1894: [Lexington, Ky.] Univ. Kentucky Press, 257 p., illus., 1967.

Chapter headings in this historical review are: federal science in the trans-Mississippi west after 1865—work of King, Hayden, and Powell; founding of the U.S. Geological Survey in 1879—King as director until 1881; a bureau of mines and mining; research in geology and paleontology—change of emphasis under Powell; advancement in topography—the National Map; new position of practical science; Congress grants permanence, 1886; Yellowstone Park—the Geological Survey and conservation; irrigation survey (1888–1890)—science and reform; interval of decline, 1892–1894; and epilogue—the survey in the 20th century.—ESL

04775 **Mantei, Erwin Joseph.** Variation in gold content of minerals of the Marysville quartz diorite stock, Montana [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 944B–945B, 1967.

Manuel, O. K. *See* Alexander, E. C., Jr. 04672

Mardirosian, Charles A. *See* Nackowski, M. P. 04851

04670 **Marti, K.** Trapped xenon and the classification of chondrites: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 193–196, illus., tables, 1967.

The concentrations of Ar, Kr and Xe have been determined in some carbonaceous and disequilibrium chondrites. From these results, and others reported in the literature, it is seen that the chondrites display rather constant abundance ratios for the heavy rare gases, but variable concentrations. The concentrations of trapped Xe are related to chondritic disequilibrium and can be used for classification purposes.—Author's abstract

04834 **Martin, Paul S.** Pleistocene overkill: Nat. History, v. 76, no. 10, p. 32–38, illus., 1967.

As the last ice retreated, and man advanced southward, about 70 percent of the large animals disappeared; the cause is still controversial. No similar loss of small vertebrates, plants, or marine life is seen. This extinction varied from others in that it far exceeded replacement by new species. One hypothesis is that sudden climatic change caused extinction, but it seemed to occur when conditions were improving, and more became extinct in the tropics than farther north. Martin hypothesizes that destruction by man was responsible; the pattern and timing correspond to only one event, the arrival of hunters. Modern Africa has more large animals than other areas but the megafauna represents only 70 percent of the Pleistocene species. If a major wave of extinction is found prior to man's arrival, the hypothesis will be disproved.—ESL

04378 **Mattick, Robert E.** A seismic and gravity profile across the Hueco bolson, Texas, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D85-D91, illus., 1967.

In February and March, 1966, the U.S. Geological Survey obtained seismic and gravity data on a 20-mile profile extending from the base of the Franklin Mountains to near the base of the Hueco Mountains near El Paso, Tex. The geophysical data indicate that a deep structural trough bounded on the west by a large normal fault and filled with unconsolidated Hueco bolson deposits parallels the base of the Franklin Mountains. The maximum thickness of the Hueco bolson fill in the center of this trough is calculated to be about 9,000 feet.—Author's abstract

Mattson, Peter H. *See* Glover, Lynn, 3d. 04592

04571 **May, Irving; Cuttitta, Frank.** New instrumental techniques in geochemical analysis, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 112-142, illus., tables, 1967.

Geochemical studies are growing in size and scope. Methods described are chromatography, both gas and thin-layer; activation and fission-track analysis; Mössbauer spectrometry; atomic absorption spectrometry, including atomic fluorescence; optical emission spectrometry, including controlled atmosphere arc, inert atmosphere spark, laser probe, and microspark excitation; and X-ray fluorescence spectroscopy. Geochemical applications of each are given.—ESL

Maynard, J. Barry. *See* Doyle, Larry J. 04511

04430 **McCaleb, James A.; Willingham, Robert W.** Influence of geologic heterogeneities on secondary recovery from Permian Phosphoria reservoir, Cottonwood Creek field, Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 10, p. 2122-2132, illus., table, 1967.

The Cottonwood Creek field, discovered in 1953, is on a west-southwest dipping monoclinal surface, about 15 miles east of Worland, Wyo. The field is a stratigraphic trap; production is from bioclastic carbonates of the Permian Phosphoria dolomite which grade updip into impermeable red shales and anhydrite. The reservoir did not respond to standard methods of secondary recovery; up-structure gas injection and up- and mid-structure water injection resulted in poor reservoir performance, and gas-oil ratios and total field oil rates continued to decline. Re-evaluation of geologic data indicated that Phosphoria heterogeneity and a superimposed fracture system were the primary causes. A new "pressure pulsing" program, alternating injection cycles with producing cycles, increased oil rates and is expected to improve ultimate oil recovery.—BHK

McCallum, K. J. *See* Campbell, C. A. 04447

McCormick, C. Larry. *See* Hayes, Miles O. 04327

04351 **McCulloh, T. H.; LaCoste, L. J. B.; Schoellhamer, J. E.; Pampeyan, E. H.** The U.S. Geological Survey—LaCoste and Romberg precise borehole gravimeter system—Instrumentation and support equipment, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D92-D100, illus., 1967.

A special modification of the LaCoste and Romberg astatized spring-type geodetic meter is the gravity sensor of the precise borehole gravimeter system. The sensor and certain support components are insulated and operate normally at a thermostatically controlled 101°C. Signals are transmitted to an instrument package housed in a steel cylinder capable of withstanding up to 4,000 psi. An electrically driven and controlled wire-line hoist permits stopping the gravimeter at any point marked on the cable and provides continuously variable cable speeds of 12-400 fpm. Heavy damping of the gravimeter beam and generally quiet conditions in the borehole permit the gravimeter to be leveled and read remotely in the unanchored

sonde. Overall precision of gravity determinations is better than 0.016 mgal for all depths.—*from* Authors' abstract

04352 **McCulloh, T. H.; Schoellhamer, J. E.; Pampeyan, E. H.; Parks, H. B.** The U.S. Geological Survey–LaCoste and Romberg precise borehole gravimeter system—Test results, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575–D, p. D101–D112, illus., 1967.

A borehole gravimeter system and components characterized by precision of (1) depth measurements in the range of 0.05 to 0.2 ft between the surface and 9,500-ft depth, and (2) downhole gravity measurements ranging from a high of 0.008 mgal to a low of 0.02 mgal have been developed. An average precision of 0.016-mgal is attainable at all depths and includes both precision of gravimeter readings and of depth measurements. Detailed (one station every 100 ft) and precise (±0.01 mgal) gravimeter surveys of wells less than 10,000 ft deep may be made at 300 to 500 ft per hour (including base checks for drift control). In the laboratory, an increase or decrease in environment temperature of 60°C on the gravity sensor produces a maximum change in apparent gravity reading of 0.1 mgal. Reliability of the gravity sensor and certain of its key components is undergoing gradual improvement.—*from* Authors' abstract

04710 **McDowell, Fred W.; Kulp, J. Laurence.** Age of intrusion and ore deposition in the Robinson mining district of Nevada: Econ. Geology, v. 62, no. 7, p. 905-909, illus., table, 1967.

The Robinson mining district of Nevada is a classic example of hydrothermal copper deposit in which the copper mineralization can be associated with hydrothermal alteration in the host rock. The averages of six K/Ar ages of primary minerals from the host intrusive and of two hydrothermal biotites agree within the analytical precision of the method. The data allow a maximum of about 2 m.y. for the interval between intrusion and sulfide mineralization for this deposit.—Authors' abstract

04776 **McDowell, Stewart Douglas.** The intrusive history of the Little Chief granite porphyry stock, central Panamint Range, California—[Pt.] 1, Structural relationships; [Pt.] 2, Petrogenesis, based on electron microprobe analyses of the feldspars [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 945B, 1967.

04319 **McIntyre, Andrew; Bé, Allan W. H.; Preikstas, Resa.** Coccoliths and the Pliocene–Pleistocene boundary, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 3-25, illus., tables, 1967.

An examination of the coccolith assemblages of 7 deep-sea cores [subtropical Atlantic Ocean], in which the Pliocene–Pleistocene boundary was identified by Ericson, Ewing, and Wollin (1963, 1964), has confirmed their findings that a major faunal and floral change did occur. A high degree of sediment mixing by organic burrowers was observed. The coccolith species indicate that the boundary probably lies within the Lower Pleistocene (probably Nebraskan–Aftonian) rather than between the Pliocene and Pleistocene because of the modern aspect of the species composition and the transition from a cold-water assemblage below the boundary to a warm-water flora above.—Authors' abstract

McKee, Bates. *See* Lister, C. R. B. 04407

McKelvey, V. E. *See* Cloud, Preston E., Jr. 04399

04777 **McMahon, Beverly Edith.** Paleomagnetic investigation of Late Paleozoic and Early Triassic redbeds of central Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 945B–946B, 1967.

Mehnert, Harold H. *See* Steven, Thomas A. 04373

04794 **Meister, Laurent Justin.** Seismic refraction study of Dixie Valley, Nevada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 955B, 1967.

Merrill, R. T. *See* Grommé, C. S. 04300

04708 **Merrill, Robert H.** Three-component borehole deformation gage for determining the stress in rock: U.S. Bur. Mines Rept. Inv. 7015, 38 p., illus., tables, 1967.

The deformation gage measures strain in a borehole resulting from relief of external stresses by overcoring. The strain is simultaneously measured along three directions intersecting at angles of 60° and lying in a plane perpendicular to the axis of the borehole. The biaxial stress field may then be calculated using measured or assumed elastic constants. Use of the gage obviates the necessity of taking measurements at differing angles at successively deeper locations in the borehole as is required with single-component gages.—KFF

Meuschke, J. L. *See* Evenden, G. I. 04377

04416 **Meyer, Joachim D.** Estudios petrográficos de ignimbritas y lavas Plio-Pleistocénicas de la zona de Ahuachapán, El Salvador, América Central: Tulane Studies Geology, v. 5, no. 3, p. 167–175, illus., 1967.

Volcanic rocks from 15 different flows in the region are examined in thin section. Four are true ignimbrites and three are sillars, the latter term being used for fused ash flows which do not show the results of plastic flow as do ignimbrites. The rest are true lava flows. Previously all had been considered ignimbrites. During the deposition of the sillar, the mixture of the ash particles and gas was not sufficiently hot to cause even a partial welding of the glass shards. The ideas of R. L. Smith (1960) are expanded upon to show that the petrographically different ignimbrites may be differentiates of the same ash flow rather than from separate flows.—HRC

Meyer, Thomas O. *See* Stroud, Lowell. 04722

04606 **Milfred, Clarence James.** Pedography of three soil profiles of Wisconsin representing the Fayette, Tama and Underhill series [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 432B, 1967.

04748 **Minard, James P.** Summary report on the geology and mineral resources of the Great Swamp National Wildlife Refuge, New Jersey: U.S. Geol. Survey Bull. 1260-E, p. E1–E14, illus., 1967.

In the eastern part of Great Swamp National Wildlife Refuge is a 2,400-acre roadless island which has been proposed for inclusion in the National Wilderness Preservation System. Most of the surface of the refuge lies between altitudes of 220 and 240 feet and consists largely of swampland and some poorly drained farmland. Small areas of glacial outwash sand form low islands in the swamp. Great Swamp, occupying the southwestern part of former glacial Lake Passaic, is bounded on three sides by hills and ridges of gneiss and basalt and on the fourth by terminal moraine. Mineral resources are principally clay and peat but also include sand, some gravel, and trap rock; only clay and peat are of possible economic significance. Because Great Swamp is underlain by sediments filling a basin carved in underlying bedrock, it has an important potential for ground water.—*from* Author's abstract

04497 **Mining in Canada.** Automation comes to ground EM: Mining in Canada, Nov., p. 11, 1967.

Digital readout and pushbutton operation will speed up EM surveys.—ARK

04866 **Mitchell, Steven W.** Stratigraphy of the Silica formation of Ohio and the Hungry Hollow formation of Ontario, with paleogeographic interpretations: Michigan Acad. Sci., Arts and Letters Papers 1966, v. 52, p. 175–196, illus., 1967.

The type section of the Hungry Hollow Formation from the Arkona–Thedford area, Ontario, is given. The first five units were formerly placed at the top of the Arkona Shale, but show much closer affinities to the overlying beds, and are included in the Hungry Hollow on the basis of marked similarity of faunas, a disconformity at the base of unit 1, and continuous gradation of units 1 through 9. A generalized section of the Silica Formation from near Sylvania, Ohio, is divided into two

members, the Brint Road and the Berkey, which are described and index fossils listed. Five possible disconformities, new subunits based on lithology and fauna and five units not previously exposed are recognized. Paleogeographic interpretation suggests that formations in the Thedford–Arkona area are also on the west side of the Findlay arch.—ESL

04492 **Montana Geological Society.** Centennial basin of southwest Montana—18th annual field conference, Aug. 1967, Guidebook: [Billings, Mont.] Montana Geol. Soc., 122 p., illus., tables, geol. maps, 1967.

Road logs for three days of field trips, totalling about 240 miles, are given along with numerous papers (cited individually) dealing with individual topics and areas pertinent to the trips. A geological map of the Madison Valley–Hebgen Lake area is included as well as a plate of very detailed columnar sections in the region.—HRC

04361 **Moody, D. W.; VanReenan, E. D.** High-resolution subbottom seismic profiles of the Delaware estuary and Bay mouth, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D247–D252, illus., 1967.

A high-resolution boomer system for continuous seismic profiling was used by the U.S. Army Corps of Engineers and the U.S. Geological Survey in a cooperative study of Delaware estuary sediments. The boomer, an electromagnetically driven low-frequency sound source, made it possible to penetrate as much as 42 m of sediment in water ranging from 2 to 35 m in depth. A resolution of less than 0.3 m produced extremely detailed profiles of subbottom structures.—Authors' abstract

Moore, Donald O. *See* Eakin, Thomas E. 04395

04674 **Moore, Willard S.** Amazon and Mississippi River concentrations of uranium, thorium, and radium isotopes: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 231–234, table, 1967.

Concentrations of uranium and thorium series isotopes were measured in two large samples of river water and associated sediment. From these data an oceanic residence time for uranium of 4 m.y. is calculated. The concentration of Th-232 in these rivers is an order of magnitude greater than in surface Atlantic waters. The amounts of Th-230 and Ra-226 being supplied to the ocean directly from rivers are less than 4 percent of that coming from other sources.—Author's abstract

04553 **Mortensen, Kay Sherman.** A fundamental study of cratering in granular materials with an application to lunar craters [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 1063B, 1967.

Moxham, R. M. *See* Wallace, R. E. 04385

04369 **Mullen, Roy.** Automatic plotter for map base preparation, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D289–D291, illus., 1967.

The Autoplot, an automatic coordinate plotting system, developed by the U.S. Geological Survey for preparing base sheets used in map compilation, consists of a (1) standard coordinatograph modified by addition of stepping motors to drive the coordinate arms; (2) plotting head redesigned to perform point plotting, line scribing, and labeling; (3) control-logic unit for generating commands for stepping motors; and (4) magnetic-tape reader for supplying data to the logic unit. Computer programs process basic data, and coded commands are recorded on magnetic tape for plotting map projections and grids, basic control points, stereomodel pass points, and identification labels. The system features high precision and compatibility with existing instrumentation. Automatic plotting time for a complete map base is usually less than one hour.—Author's abstract

04389 **Mullineaux, Donal R.; Bonilla, Manuel G.; Schlocker, Julius.** Relation of building damage to geology in Seattle, Washington, during the April 1965 earthquake, *in*

Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D183-D191, illus., 1967.

The strong Puget Sound earthquake of April 29, 1965 caused widespread but generally mild damage. In the city of Seattle, a relation between building damage and the distribution of geologic formations at the surface was locally recognizable, but was imperfectly developed and less well expressed than the marked relation reported for many strong earthquakes. The most severe damage occurred over an area underlain in part by compact Pleistocene sediments and in part by less compact postglacial deposits and artificial fill, in a pattern evidently controlled by some factor other than surface distribution of geologic materials.—Authors' abstract

04409 **Mundorff, M. J.** Ground water in the vicinity of American Falls Reservoir, Idaho: U.S. Geol. Survey Water-Supply Paper 1846, 58 p., illus., tables, 1967.

The American Falls Reservoir in southeastern Idaho lies near the south margin of the Snake River Plain which is underlain by a thick sequence of basaltic lava flows, interbedded pyroclastics, and sedimentary deposits. The uppermost few thousand feet of this sequence is the Snake Plain aquifer, one of the great aquifers of the U.S. Recharge is chiefly by water percolating from the Snake River, its tributaries, and irrigated tracts, and by underflow from surrounding areas; total discharge is about 9,000 cfs. Less permeable deposits underlie the reservoir area and act as a barrier to ground-water movement. Under present conditions, reservoir stage has little effect on ground-water inflow. After about 1952, greatly increased ground-water withdrawals from wells virtually balanced increased diversions from the surface-water system for irrigation.—*from* Author's abstract

Murdoch, J. *See* Geissman, T. A. 04843

04701 **Murray, D. Keith; Bortz, Louis C.** Eagle Springs oil field, Railroad Valley, Nye County, Nevada: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 10, p. 2133-2145, illus., 1967.

Eagle Springs oil field, Nevada's sole producing area, to date has 13 productive wells and estimated recoverable reserves of 10,000,000 bbl of oil. Most of the oil comes from lacustrine carbonate rock of the Eocene Sheep Pass Formation, and from porous zones in Oligocene tuff. The pay zones are discontinuous. Oil is trapped by impermeable Miocene "valley fill" which overlaps truncated Oligocene and Eocene reservoir beds along a northwest-plunging anticlinal nose at the base of the Miocene. A major fault-zone provides closure on the east.—WCC

04778 **Murray, Frederick Nelson.** The stratigraphy and structural geology of the Grand Hogback monocline, Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 946B, 1967.

Murray, Grover E. *See* Bonet, F. 04825

Murray, Grover E. *See* Weidie, A. E., Jr. 04829

Murray, Grover E. *See* Weidie, A. E., Jr. 04830

04522 **Murthy, V. Rama; Stueber, Alan M.** Potassium-rubidium ratios in mantle derived rocks, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 376-380, illus., tables, 1967.

The K/Rb and the K variation in various materials is shown. Basalts reveal a systematic variation of K/Rb with K, though there is no systematic variation in eclogite and ultramafic inclusions, or in alpine-type intrusions, although K varies widely. The K/Rb values are average crustal and alkali basalt values. The oceanic tholeiite values are low. The upper mantle is, therefore, low in K/Rb values and lower than that usually presumed for mantle material. It is possible that the upper mantle differentiated from the primitive mantle early in Earth history, the crust being a later differentiate. This early differentiation could have produced an alkali-rich upper mantle with low K/Rb. Alpine peridotites are residuals from this upper mantle, with the alkalies having been drained to the crust.—HRC

04851 **Nackowski, M. P.; Mardirosian, Charles A.; Botbol, Joseph M.** Trend-surface analysis of trace chemical data, Park City district, Utah: Econ. Geology, v. 62, no. 8, p. 1072–1087, illus., tables, 1967.

Nearly 150 widely spaced soil samples were analyzed for Cu, Pb, Zn, and Mn by X-ray spectrometer. The contoured results reveal known mineralized zones. Cu, Pb, and Zn abundance has an approximately lognormal distribution, and that of Mn is normal. First-, second-, and third-degree trend surfaces establish an ESE trend for Cu–Pb–Zn; this is superposed on ENE trend of individual mines and orebodies.—WSW

04779 **Nagle, Frederick, Jr.** Geology of the Puerto Plata area, Dominican Republic [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 946B–947B, 1967.

Nakagawa, H. M. *See* Ward, F. N. 04359

04299 **Narasimhan, T. N.** Note on 'A new approach for estimating transmissibility from specific capacity' by R. Theodore Hurr [1966]: Water Resources Research, v. 3, no. 4, p. 1093–1095, illus., 1967.

The author has been working on the same problem as Hurr [ibid., v. 2, no. 4, p. 657–664, 1966], but from a different angle. A chart is described and illustrated, using the set of factors making up the Theis equation, to solve rapidly every type of problem involving this equation.—ESL

04440 **Navarra, John Gabriel; Strahler, Arthur N.** Our planet in space—The earth sciences: New York, Harper and Row, 544 p., illus., 1967.

The 24 chapters of this elementary textbook are divided into five units: (1) interpreting our Earth through energy systems (contains a chapter on Earth sciences); (2) energy systems of planet Earth—Earth's motion, solar energy, impacts, and stars; (3) energy systems of atmosphere and oceans; (4) energy exchanges in the land-surface zone—includes flowing water, glacial ice, waves, tides, and winds; and (5) energy systems in the Solid Earth—covers rise of magma, bending and breaking of the crust, rifting of ocean basins and continents, and energy systems throughout geologic time. An outline review, self-testing quiz, references, and a suggested investigation are given for each chapter.—ESL

04780 **Neavel, Richard Charles.** Sulfur in coal—Its distribution in the seam and in mine products [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 947B, 1967.

04558 **Negev, Moshe.** A sediment model on a digital computer [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 981B, 1967.

04590 **Nelson, Arthur E.; Tobish, Othmar T.** The Matilde and Milagros Formations of Early Tertiary age in northwest Puerto Rico, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1966: U.S. Geol. Survey Bull. 1254-A, p. A19–A23, illus., 1967.

04737 **Nelson, Arthur E.** Geologic map of the Utuado quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-480, scale 1:20,000, sections, text, 1967.

Consolidated rocks, ranging from Cretaceous to middle Tertiary, are exposed in the Utuado quadrangle. Except where Cretaceous and early Tertiary formations are separated by faults, sedimentary contacts and those of middle Tertiary age are conformable. A thick sequence of massively bedded volcanic breccia and associated rocks is here named the Jobos Formation. In the southern part of the quadrangle, a large body of intrusive rock, mostly granodiorite, forms part of the Utuado pluton. Intense hydrothermal alteration is present in several places, especially along the Caniaco fault. Even though older stratified rocks have been folded and faulted, in general, they strike parallel to the projected axial trace of the anticlinorium; joints

are widely dispersed in all pre-Oligocene exposed rocks. Limestone, sand, and gravel are the principal mineral resources.—MCM

04758 **Nelson, R. B.** A failure of boudinage structure in a marble to indicate the principal direction of tectonic transport and thinning [abs.]: Nebraska Acad. Sci. Proc., 77th Ann. Mtg., p. 18, 1967.

04719 **New Orleans Geological Society; Weidie, A. E., Jr.** (compiler). Yucatán field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7, Yucatán Peninsula: New Orleans, La., New Orleans Geol. Soc., [163] p., illus., tables, 1967; originally published 1962.

This field trip was designed to study modern and Cenozoic carbonate deposits in the northern part of the Yucatán Peninsula, their karst features and hydrogeology; and of observing, at Chichen-Itza and Uxmal, archeological ruins of the highest developed Indian culture known in North America. Four papers from the first edition (1962) are reprinted here (Murray and Weidie, Bonet and Butterlin, West, and Folk); new papers added are by Back and Hanshaw, Harding, Ward, and an excerpt from S. G. Morley's *The ancient Maya* (1956 edition). All but the last one are cited individually.—GDC

04781 **Niazi, Mansour.** Partition of seismic energy [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 947B–948B, 1967.

04645 **Nichols, Maynard; Poor, George.** Sediment transport in a coastal plain estuary: Am. Soc. Civil Engineers Proc., v. 93, paper 5571, Jour. Waterways and Harbors Div., no. WW4, p. 83–95, illus., 1967.

Observations of net flow and suspended sediment were made in the Rappahannock Estuary, Va., to delineate patterns of transport that lead to partial entrapment of sediment in the middle estuary. The estuary is characteristic of the partly mixed type; its main channel is bordered by extensive submerged shoals. River-borne sediments are flushed downstream through the upper estuary mainly over the shoals. In the middle estuary, sediment is partly entrapped on the north shoals or deposited on the basin floor. Another part is redistributed headward in the channel along with estuarine produced organic constituents. Upstream transport by density currents is augmented by alternating tidal flow that favors differential settling and selective transport of coarse-grained particles. Near the head, rapid advective mixing and moderate tidal turbulence act to deter deposition and recirculate sediment downstream over the shoals.—*from* Authors' abstract

04782 **Nickey, David Allen.** Ostracodes from the Middle Ordovician Nealmont Limestone of central Pennsylvania [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 948B, 1967.

04322 **Nielsen, John P.** Consolidation and geochemistry of some clays: Am. Soc. Civil Engineers Proc., v. 93, paper 5554, Jour. Soil Mechanics and Found Div., no. SM6, p. 49–59, illus., tables, 1967.

The two-parameter power law has been used to describe the viscous resistance to compression occurring during soil consolidation. This paper attempts to appraise the two empirical constants appearing in the power law. Specifically, an attempt is made to relate these constants to the mineralogical, chemical, and physical properties of a select set of remolded clays. Expressions for these constants are presented which are analogous to the Skempton relationship for the compression index of normally consolidated clay.—Author's abstract

Noble, Donald C. *See* Colton, Roger B. 04754

Norton, Norman J. *See* Hall, John W. 04857

04609 **Nybakken, Bette Helene Halvorsen.** The paleoecology of southwest Umnak Island and southwest Kodiak Island, Alaska [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 488B, 1967.

Obradovich, John D. *See* Steven, Thomas A. 04373

04427 **Ocean Industry.** A new exciting tool for mineral exploration: Ocean Industry, v. 2, no. 12, p. 17–19, illus., 1967.

The feasibility of operating a high-sensitivity marine gradiometer/magnetometer at sea has been proven, and the results of these runs are being evaluated with respect to the different tasks performed in mineral and petroleum exploration, or with respect to search and salvage application. For each of these applications, the requirements of the gradiometer are different: The spacing, for example, may have to be varied considerably; the sensors can be towed in longitudinal (tandem) fashion 100 feet or more apart. A third sensor is soon to be installed atop a boom above one sensor of this transverse gradiometer to obtain the vertical gradient. Automatic methods of computing and displaying distances and directions related to small anomalies are also under development and should find use in numerous applications.—Author's summary

04863 **O'Connell, Richard J.; Wasserburg, G. J.** Dynamics of the motion of a phase change boundary to changes in pressure: Rev. Geophysics, v. 5, no. 4, p. 329–410, illus., tables, 1967.

The dynamic response of a phase boundary to sudden changes in pressure was investigated by considering a one-dimensional model of two layers separated by a phase change. The distribution of heat sources and convective heat transport are shown to be of minor importance to motion of the phase boundary. Important parameters are latent heat of phase change and difference in slope between the Clapeyron curve and temperature distribution in the Earth; long term motion depends on overall geometry of the model and boundary condition at depth. Results indicate the time at which thermal blanketing by sediments becomes important, and the effect of rate of sedimentation on response of the system. The effect of isostasy in conjunction with a shallow phase change is of major importance. Results can be obtained on more complex models by relatively simple calculations.—VSN

04551 **Odum, Howard Thomas.** The biogeochemistry of strontium—With discussion on the ecological integration of elements [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 1042B, 1967.

04499 **O'Hara, M. J.** Mineral facies in ultrabasic rocks, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 7–18, illus., 1967.

Mineral stabilities under differing temperatures, pressures, and chemical components are discussed for the system CaO–MgO–SiO_2 and for assemblages of these minerals, and they are compared with melting curves for the corresponding ultramafic rocks with small amounts only of Al_2O_3 and FeO. Mineral facies in the system CaO–MgO–$Al_2O_3SiO_2$–H_2O are also discussed; they are the anhydrous facies, amphibole-bearing facies, serpentinites and other hydrous facies, and melilite and monticellite-bearing facies. A generalized facies model based on the system CMASH is shown in order to accomodate FeO replacing MgO; Fe_2O_3 and Cr_2O_3 in part replacing Al_2O_3; and TiO_2 and Na_2O entering into plagioclase, pyroxene, or amphibole. Correlations of the ultramafic assemblages with those of basic, pelitic, and calcareous rocks are shown.—HRC

04518 **O'Hara, M. J.** Crystal-liquid equilibria and the origins of ultramafic nodules in basic igneous rocks, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 346–349, table, 1967.

O'Hara assumes that basalt originates in the mantle and fractionates during ascent. The ultramafic nodules are related to this process; crustal xenoliths are unlikely. Nodule suites can be arranged in geochemical sequence based on ratio changes, and the sequence can then be used to predict portions of phase diagrams, from high to low temperature, if a particular process is assumed for the nodule formation. Several hypotheses can be suggested, and each tested for any given suite. Alternative predictions can then be evaluated from experimental data or tested directly against suitable experiments. Some specific differences between the predictions of three different hypotheses are tabulated.—HRC

04524 **O'Hara, M. J.** Mineral parageneses in ultrabasic rocks, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 393–403, illus., 1967.

The mineralogy of two fixed ultrabasic compositions varies with pressure and temperature as a result of the changing solubility of Al_2O_3 in the pyroxenes and the pyroxenes in each other. A petrogenetic grid using two parameters of clinopyroxenes coexisting with orthopyroxene and pyroxene in an Al_2O_3–saturated environment is used. Estimates of temperature and pressure for clinopyroxenes in equilibrium can be plotted. Clinopyroxenes from peridotites of layered intrusions and alpine-type intrusions, and from peridotites occurring as nodules in basalt, kimberlite, and other breccia pipes are studied. Eleven conclusions are reached as a result of the comparisons.—HRC

04541 **O'Hara, M. J.** Garnetiferous ultrabasic rocks of orogenic regions, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 167–172, 1967.

Pyrope-rich pyralspite garnet-magnesian olivine peridotite facies rocks occur only in Europe among gneisses and schists of the amphibolite or hornblende granulite mineral facies restricted to Caledonian-metamorphosed rocks. Petrographic details indicate that all may represent layered spinel-bearing ultrabasic masses containing high Al_2O_3 pyroxenes crystallized from basic magmas at the base of the crust prior to orogenesis. Spinel-peridotite facies group occurs only in six isolated, independent places; each is described. Problems for solution are the origins of the chemical variations in the masses and the circumstances leading to emplacement of masses reflecting such different conditions of crystallization in different orogenic areas.—HRC

Okuda, Susumu. *See* Faruqi, F. A. 04406

04306 **Olausson, Eric.** Climatological, geoeconomical and paleooceanographical aspects on carbonate deposition, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 245–265, illus., tables, 1967.

Deposition of calcium carbonate in the Atlantic and Pacific Oceans is calculated, considering Ca discharge to the sea by river waters, mineralization, dissolution, early diagenetic reactions, circulation of ocean waters, and equilibria established during times of stable climate. Accumulation of $CaCO_3$ at present in the North Atlantic is about half the percentage expected if the inflow of Ca was equal to the outflow; there is a net outflow of Ca from the North Atlantic to other oceans, with higher Ca concentrations in cold, deep outflowing water than in warm, inflowing surface water. There is a net inflow of Ca to the Pacific Ocean. In North Atlantic cores of Pleistocene glacial stages, Ca content averages about 40 percent less than in interglacial stages; corresponding cores in the equatorial Pacific show increase in Ca content, indicating increase in net Ca transport.—VMJ

Olson, G. W. *See* Dijkerman, J. C. 04459

04861 **Ormiston, A. R.** Lower and Middle Devonian trilobites of the Canadian arctic islands [with French abs.]: Canada Geol. Survey Bull. 153, 148 p., illus., tables, 1967.

Trilobite faunas of Lower Gedinnian, Emsian, Eifelian, Givetian, and possible Siegenian age are present. Assemblages show affinity with Europe and the Uralian province, but also a degree of endemism. Thirty-four species are described and assigned to 19 genera; new taxa comprise two genera, one subgenus, 23 species, and one subspecies. Age assignments proposed are: strata at Washington Point, Baillie Hamilton Island, Lower Gedinnian; at Drake Bay, Prince of Wales Island, Eifelian part; Stuart Bay Formation, Emsian part; Eids Formation, Emsian; strata on the largest Princess Royal Island, Emsian and/or Eifelian; Blue Fiord Formation, Eifelian; and Bird Fiord Formation, mostly Givetian. During Eifelian time the Canadian Arctic was part of a Uralian province. Phylogeny of the Dechenellinae is considered in detail.—*from* Author's abstract

04678 **Osborne, F. Fitz.** Appalachian region of Québec—Some aspects of its divisions and geology, *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 18–24, illus., table, 1967.

A review of the nomenclature of the longitudinal divisions of the Appalachian region of Quebec shows such glaring inconsistencies of usage that a new series of names is justifiable. The informal transverse divisions are, however, more reasonably serviceable for the geologist. The present interpretation of the geology is essentially that postulated by Logan in 1843 but abandoned by workers from 1890 until 1950.—Author's abstract

04398 **Oualline, Royce E.** George Sawtelle (1892–1967): Houston Geol. Soc. Bull., v. 10, no. 4, p. 16–17, 1967.

04391 **Ovenshine, A. Thomas.** Provenance of recent glacial ice in lower Glacier Bay, southeastern Alaska, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575–D, p. D198–D202, illus., 1967.

Erratics of staurolite schist, chiastolite schist, biotite–quartz schist, amphibolite, gabbro, and pyroxenite are common constituents of beach gravels in lower Glacier Bay west of a line near Sturgess Island, Sandy Cove, and Hutchins Bay. These erratics were derived from the Fairweather Range and their present distribution describes the extent of glacial ice from that source, here termed the Russell drainage, in about A.D. 1740. The Muir drainage area may also have contributed ice to lower Glacier Bay but because ice from the Russell system had a much larger extent, it is suggested that discharge from the Russell glacier greatly exceeded discharge from the Muir. Probably the glacial drainage from the Muir area was partly or completely blocked by flow from the Russell glacier; ponding thus produced may have caused development of the extensive icefield observed in the Muir region by early visitors.—Author's abstract

04370 **Page, Norman J.; Jackson, Everett D.** Preliminary report on sulfide and platinum-group minerals in the chromites of the Stillwater Complex, Montana, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575–D, p. D123–D126, illus., 1967.

Platinum-group minerals, previously known to occur in the layered gabbros of the Banded and Upper zones of the Stillwater Complex, have been found in the Ultramafic zone as well. Laurite and other complex platinum-group sulfides and sulfarsenides are present in at least four of the chromitite zones of the Peridotite member. The economic potential of these occurrences cannot be evaluated at the present time, but the possibility of obtaining platinum-group metals as a byproduct of chrome mining operations should not be overlooked in the future.—Authors' abstract

Pallen, Eldon. *See* Broadhurst, Sam D. 04628

Palmer, Allison R. *See* Stewart, John H. 04374

04762 **Palmer, James E.** Geologic map of the Saint Charles quadrangle, Hopkins and Christian Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–674, scale 1:24,000, section, text, 1967.

Coal is being mined at five locations in the Saint Charles quadrangle, some strip and some underground. Thickness of beds ranges from 2–6 feet; only moderate reserves remain. Oil has been produced since 1925; present production is in the Southard Pool at a depth of about 2,000 feet with yield of about 40 bbl per day. Gas wells in the Southard Pool are now abandoned, but recent discoveries have been made at depths of less than 2,500 feet in several Upper Mississippian formations. A large eastward-trending anticline in the north-central area provided structural control for accumulation of most gas reserves. Oil accumulated in stratigraphic traps.—MCM

Pampeyan, E. H. *See* McCulloh, T. H. 04351

Pampeyan, E. H. *See* McCulloh, T. H. 04352

Pankratz, L. B. *See* King, E. G. 04728

Panos, Vladimír. *See* Stelcl, Otakar. 04848

04783 **Park, Richard Avery, 4th.** Paleoecology of the genus *Venericardia* (Pelecypoda) in the Atlantic and Gulf Coastal Province [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 949B, 1967.

04555 **Parker, Michael.** Studies on the distribution of cobalt in lakes [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 1281B–1282B, 1967.

Parks, H. B. *See* McCulloh, T. H. 04352

04862 **Patten, Donald W.** The biblical flood and the ice epoch—A study in scientific history (2d edition): Seattle, Wash., Pacific Meridian Publishing Co., 336 p., illus., tables, 1967; originally published 1966.

The central proposition of the book is to demonstrate the superiority of the theory of astral catastrophism over the uniformitarian view of Earth history; history of both concepts is reviewed. Other chapters cover: examples of astral catastrophism in the solar system; the tidal nature of the biblical flood; orogenesis; glacio-genesis; model of the flood catastrophe; astral catastrophism in ancient literature; the greenhouse effect; biological uniformitarianism; cosmogony and uniformitarianism; and catastrophism, uniformitarianism and western civilization.—ESL

Patterson, Sam H. *See* Sever, Charles W. 04414

Paul, E. A. *See* Campbell, C. A. 04447

04345 **Pearce, D. C.; Walker, J. W.** An empirical determination of the relative dielectric constant of the Greenland ice cap: Jour. Geophys. Research, v. 72, no. 22, p. 5743–5747, illus., 1967.

Recent measurements of 30-Mhz radar pulse propagation times and density in the icecap at Camp Century, Greenland, have been used to obtain an empirical relation between ice density and relative dielectric constant. The resulting dependence between density and dielectric constant, which is in agreement with the dielectric theory of Polder and Van Santen, yields a relative dielectric constant of deep ice of 3.31 ± 0.04, corresponding to a density of $0.920\ g/cm^3$.—Authors' abstract

Pearson, Cynthia A. *See* Collins, A. Gene. 04724

Peavey, R. C. *See* Green, Cecil H. 04402

Peck, Dallas L. *See* Decker, Robert W. 04387

04649 **Pecora, William T.; Rubin, Meyer.** Absolute dating and the history of man, *in* Time and stratigraphy in the evolution of man—NAS-NRC, Div. Earth Sci., Symposium, Washington, D. C., 1965: Natl. Acad. Sci.-Natl. Research Council Pub. 1469, p. 43–56, illus., table, 1967.

The authors evaluate the numbers and methods applicable to geologic events of the past few million years, particularly with reference to man or to hominid remains. Because geologic techniques of correlation are so insensitive to stratigraphic sections formed under continental conditions, absolute dating will likely be the most rewarding technique if some rigid validity controls are applied. Validity must be fulfilled in three areas: experimental method employed, geochemical "fitness" of the sample, and geologic intelligence. The probability of ideality and truly

"absolute" chronometry is too remote to be expected, except for an odd sample.—MST

04784 **Peper, John Dunkak.** Stratigraphy and structure of the Monson area, Massachusetts–Connecticut [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 949B–950B, 1967.

04660 **Pepin, Robert O.** Trapped neon in meteorites: Earth and Planetary Sci. Letters, v. 2, no. 1, p. 13–18, illus., 1967.

Diffusive fractionation and two-component models for trapped meteoritic neon are reexamined in terms of the isotopic composition of neon in carbonaceous chondrites. Strong evidence is found for two independent neon components. Murray contains variable amounts of "solar" neon with Ne-20/Ne-22 = 14.3. All carbonaceous chondrites appear to contain a second neon component with Ne-20/Ne-22 = 8.2. Observed ranges of trapped Ne-20/Ne-22 ratios in carbonaceous chondrites are reflections of varying degrees of mixing of these two. There is no evidence for severe diffusive losses. Isotopic composition of trapped solar neon in gas-rich meteorites indicates that terrestrial neon may not have been produced by diffusive fractionation of solar neon. Variations in neon composition in certain gas-rich chondrites and achondrites suggest that a two-component trapped neon mixture may also be present.—*from* Author's abstract

Perrault, G. *See* Chao, G. Y. 04633

Petersen, Richard G. *See* Shaw, Charles E., Jr. 04832

Petkewich, Richard M. *See* Fields, Robert W. 04491

Phillips, H. Boyd. *See* Glover, Robert E. 04741

04661 **Philpotts, John A.; Schnetzler, C. C.; Thomas, H. H.** Rare-earth and barium abundances in the Bununu howardite: Earth and Planetary Sci. Letters, v. 2, no. 1, p. 19–22, illus., table, 1967.

Abundances of 8 rare-earth elements and barium have been determined in the Bununu howardite—a major type of calcium-rich achondrite distinguishable from the other major type, eucrite, by dominance of hypersthene over pigeonite or by a lime content of less than 10 weight percent. This meteorite is one of a group having the same relative abundances of rare earths, barium, and some other elements. Available data indicate that similar "unfractionated sequences" exist for terrestrial rocks. The calcium-rich achondrite sequence can be explained in terms of addition or subtraction of hypersthene; trace-element data indicate that crystallization of pigeonite and plagioclase cannot have played an important role in differentiation. Lack of europium anomalies in many terrestrial igneous rocks preclude previous crystallization of plagioclase.—VSN

Pickering, Samuel M., Jr. *See* Smith, James W. 04393

04510 **Pilkey, Orrin H.** Shelf phosphate sands off Cape Fear, North Carolina [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 179–180, 1967.

04745 **Plafker, George.** Surface faults on Montague Island associated with the 1964 Alaska earthquake: U.S. Geol. Survey Prof. Paper 543-G, p. G1–G42, illus., geol. maps, 1967.

Two reverse faults on southwestern Montague Island in Prince William Sound, reactivated during the earthquake of March 27, 1964, are 22 and 4 miles long on land, have an average strike between N. 37° E. and N. 47° E., and dip 50°–85° N.W. Dominant motion was dip slip; the blocks northwest of the faults were relatively upthrown as much as 23 feet, and both blocks were upthrown relative to sea level. The surface faults lie within a narrow zone of crustal attenuation and maximum uplift associated with the earthquake that may extend discontinuously for more than 300 miles from Montague Island to the area offshore of Kodiak Island. Available data suggest that they are probably subsidiary features rather than the causative faults along which the earthquake originated.—GF

04675 **Pollack, Henry N.** Thermal stresses at the oceanic–continental margin: Earth and Planetary Sci. Letters, v. 2, no. 2, p. 116–118, illus., 1967.

Dissimilar temperature profiles beneath oceans and continents give rise to thermoelastic stresses at and adjacent to the oceanic–continental margin. Computations of the magnitude and orientation of the maximum shear stress field reveal a zone of shear dipping beneath the continent from the margin.—Author's abstract

Poor, George. *See* Nichols, Maynard. 04645

Preikstas, Resa. *See* McIntyre, Andrew. 04319

04424 **Quebec Dept. of Natural Resources.** (Geological Services). Annotated bibliography on metallic mineralization in the regions of Noranda, Matagami, Val-d'Or, Chibougamau [also French edition]: Quebec Dept. Nat. Resources Spec. Paper 2, 284 p., geol. maps, 1967.

This annotated bibliography and accompanying maps follow the one published in 1963 concerning the Appalachian province. About 1,400 metallic mineral occurrences in these districts are described. The entries are arranged under townships, and consist of the location, mining companies, symbols for metals, and abbreviations for minerals. The six sheets comprising the colored geologic and mineral map are improved versions of Preliminary Maps 835 and 850.—ESL

Radomski, Andrzej. *See* Gradziński, Ryszard. 04820

04381 **Radtke, Arthur S.; Taylor, Charles M.; Frost, John E.** Bismuth and tin minerals in gold- and silver-bearing sulfide ores, Ohio mining district, Marysvale, Utah, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D127–D130, illus., tables, 1967.

Large amounts of cuprobismutite and bismuthinite are present in gold- and silver-bearing sulfide ores in the Tunnel Extension Number Two mine near Marysvale, Utah. Significant amounts of cassiterite in small grains are concentrated in the quartz gangue. Most of the silver is present in cuprobismutite, and gold occurs as the native metal. Carbonate beds below the mine, mineralized elsewhere in the district, offer potential exploration targets.—Authors' abstract

04540 **Ragan, Donal M.** The Twin Sisters dunite, Washington, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 160–167, illus., 1967.

The Twin Sisters dunite, approximately 90 sq km, is the largest intrusive body in the Cascade peridotite belt. Tertiary in age and post-orogenic in origin, it is a typical reddish-brown weathering, enstatite-bearing dunite. Olivine, enstatite, chromite, and clinopyroxene are common. Primary(?) structures, early flow structures, transitional, and cataclastic and related structures are described. Serpenitization proceeded from the edges inward. The mass was intruded as a solid and no relationship between an igneous magma or stage can be demonstrated.—HRC

04543 **Raleigh, C. B.** Experimental deformation of ultramafic rocks and minerals, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 191–199, illus., table, 1967.

The weakening and embrittlement of serpentine at dehydration or under high pore-pressure resulting from ultramafic intrusion into wet sedimentary rocks will explain alpine serpentinite's being emplaced tectonically by marginal faulting. Kink bands and lamellae parallel to [100] in naturally-deformed olivine result from translation gliding in [100], and are favored by high temperature or slow strain rates. Other ultramafic minerals have been similarly deformed artificially. Diopside lamellar twinning parallel to [100] is favored where the resolved shear stress on the twin-

glide system is high. This can be used to determine orientation of principal stresses in naturally deformed rocks.—HRC

04607 **Ranney, Richard Willard.** Soil forming processes in glossoboralfs of west-central Wisconsin [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 433B, 1967.

04367 **Rantz, S. E.** Mean annual precipitation–runoff relations in north coastal California, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D281-D283, illus., table, 1967.

Mean annual runoff is linearly related to mean annual precipitation and potential evapotranspiration in the humid basins of north coastal California. Mean annual water loss is virtually independent of mean annual precipitation because the great bulk of the annual precipitation and runoff occur in the winter months when evapotranspiration demands are light.—Author's abstract

Rao, B. Rama. *See* Baur, W. H. 04716

Rao, M. N. *See* Clark, R. S. 04341

04443 **Rao, M. N.** Osmium in three iron meteorites: Jour. Geophys. Research, v. 72, no. 22, p. 5758-5759, table, 1967.

The osmium contents of three iron meteorites (Tocopilla, Casas Grandes, and Odessa) have been determined spectrochemically. The values obtained compare well with those determined by neutron activation (Herr and others, 1961) but are somewhat higher. The Ru/Os ratio for Odessa is about 2. A similar coarse octahedrite in which both Ru and Os have been determined, Canyon Diablo, has a Ru/Os ratio of about 3. Within the range of experimental error, the coarse octahedrites seem to yield similar osmium as well as ruthenium concentrations.—DBV

04864 **Rawson, Richard Ray.** Petrographic facies analysis of the Ray Member Kibbey Formation, Williston Basin and central Montana [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 950B, 1967.

04785 **Ray, Dipak Kumar.** Geochemistry and petrology of the Mt. Trident andesites, Katmai National Monument, Alaska [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 950B-951B, 1967.

04356 **Ray, Louis L.** An interpretation of profiles of weathering of the Peorian Loess of western Kentucky, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D221-D227, illus., tables, 1967.

The surficial mantle of Peorian Loess in western Kentucky is the parent material for soils of the Memphis catena (Memphis, Loring, Grenada, Calloway, and Henry). These soils have distinct profiles of weathering which are gradational from those of the Memphis to those of the Henry soil. Interpretation of the profiles of weathering and of the silt-clay ratios of their component zones indicates that the profile characteristics result from normal weathering and that it is not necessary to postulate two distinct loess deposits, two separate periods of profile development, or periglacial climatic conditions to explain their genesis. Maturely developed profiles of weathering are believed to be the same age in years as those that are less well developed and seemingly more youthful.—Author's abstract

04337 **Read, Charles B.; Wanek, A. A.** *Excerpts from* Stratigraphy of outcropping Permian rocks in parts of northeastern Arizona and adjacent areas, *in* Guidebook of Defiance-Zuni-Mt. Taylor region, Ariz., N. Mex.—New Mexico Geol. Soc., 18th Field Conf. 1967: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 122-124, 1967; originally published 1961.

The Permian rocks in the Zuni uplift in New Mexico are correlated with those in the Defiance uplift in Arizona. The Abo Formation, at the base of the section in the Zuni uplift is correlated with the Supai Formation in the Defiance uplift. The Yeso, Glorieta, and San Andres Formations overlie the Abo, the San Andres at the top. In the Defiance area, the DeChelly Sandstone overlies the Supai and is at the top of the section. The correlations are based upon lithology alone.—HRC

04631 **Read, Charles B.; Smith, Clay T.; Fitzsimmons, J. Paul; Werts, L. L.** Second day road log from Gallup . . . to Thoreau and return via Smith Lake, Mariano Lake, and Pinedale, *in* Guidebook of Defiance-Zuni-Mt. Taylor region, Arizona and New Mexico—New Mexico Geol. Soc., 18th Field Conf. 1967: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 97–118, illus., 1967.

Details of the geology along the 103 mile route are described. Stops are made to observe Chinle Sandstone stratigraphy at Fort Wingate, to consider structures in the region and to study the Permian Abo Formation contact with the Precambrian rocks, to study Cretaceous stratigraphy at the Black Jack uranium mine, and lastly at the Church Rock uranium mining district.—HRC

04760 **Reed, Eugene C.** George Evert Condra (1869–1958), geologist, paleontologist, naturalist, conservationist: Nebraska Acad. Sci. Proc., 77th Ann. Mtg., p. 27, 1967.

04687 **Rehder, John B.; Richardson, Robert T.** Archaeological geomorphology as applied to a specific example—The Vacherie, Louisiana shell midden [abs.]: Assoc. Am. Geographers Annals, v. 57, no. 4, p. 801, 1967.

Reid, Arch M. *See* Fredriksson, Kurt. 04594

04595 **Reid, Arch M.; Fredriksson, Kurt.** Chondrules and chondrites, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 170–203, illus., tables, 1967.

Chondrites, the most primitive major classes of meteorites, are also the most abundant. They are characterized by the presence of chondrules, spherical bodies of silicate, metal, and sulfide phases with a great variety of internal textures. Only the petrologic problems of chondrite genesis are considered. A central problem in chondrite petrology is the origin of the chondrules. Textures and minerals of chondrites are described, and the possibility of their formation by agglomeration, the role of metamorphism, and chondrule formation are discussed. Chondrules are believed to be the products of rapid cooling of droplets formed by the same process.—ESL

04552 **Reimnitz, Erk.** Late Quaternary history and sedimentation of the Copper River delta and vicinity, Alaska [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 1042B–1043B, 1967.

Rennie, D. A. *See* Campbell, C. A. 04447

04836 **Reynolds, John H.** Isotopic abundance anomalies in the solar system, *in* Annual review of nuclear science, V. 17: Palo Alto, Calif., Annual Reviews, Inc., p. 253–316, illus., tables, 1967.

Data on isotopic abundance for the solar system come from laboratory studies of meteorites, tektites, and cosmic dust; isotopic effects of tektites are not included here because of uncertainties as to tektite origin. Strongest evidence for thorough isotopic mixing in the solar system comes from isotopic uniformity in oxygen in rocks and meteorites; exceptional cases where variations occur are discussed by elements. Isotopic effects due to natural radioactivity in meteorites are divided into age of the principal phase separations and ages based on gas retention in minerals. Effects due to cosmic rays include anomalies induced in nonvolatile elements and in rare gases. Some implications of these radiation ages are discussed. The third isotopic effect is that due to extinct radioactivity. Unexplained isotopic anomalies in neon and xenon are examined also.—ESL

04297 **Reynolds, Mitchell W.** Physical evidence for Late Cretaceous unconformity, south-central Wyoming, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D24–D28, illus., 1967.

Local physical evidence in the Lamont-Bairoil area, south-central Wyoming, corroborates regional stratigraphic and paleontologic evidence of an unconformity at the base of the Teapot Sandstone Member of the Mesaverde Formation. The

new evidence includes low-angle truncation of beds beneath the Teapot Member, channels cut into underlying beds, and pebble conglomerate at or near the base of the Teapot. Clasts in the conglomerate were derived from Mesozoic, Paleozoic, and possibly Precambrian rocks eroded from the rising ancestral Wind River Range.—Author's abstract

Richardson, Robert T. *See* Rehder, John B. 04687

Rieke, Herman H., 3d. *See* Chilingar, George V. 04316

04384 **Robinove, C. J.; Skibitzke, H. E.** An airborne multispectral television system, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D143-D146, illus., 1967.

Airborne multispectral television images were obtained in the visible and near infrared ($<2.2\mu$) region of the spectrum and recorded on videotape in a light aircraft. The images are of lower spatial resolution than aerial photographs from equivalent altitude but have the advantages of allowing quite narrow bandpass filtering and instant reproduction of the images for use by interpreters. Such imagery may be quite useful for fast coverage of dynamic events, such as floods, where aerial data are needed quickly but not to the photogrammetric precision of aerial photographs. The use of airborne television imagery by field scientists also will prepare them to use similar but smaller scale data from earth-orbiting satellites.—Authors' abstract

04379 **Robinson, Edwin S.** Use of fan filters in computer analysis of magnetic-anomaly trends, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D113-D119, illus., 1967.

Potential-field maps for which data are given on a rectangular grid can be analyzed to determine anomaly lineation by means of fan-filtering techniques similar to those applied in seismic-velocity filtering. Filters can be designed to pass only elongate anomalies which strike in a preferred azimuth range. Such filters are useful for defining more clearly subtle anomaly lineations that may not be obvious on unfiltered maps.—Author's abstract

04659 **Robinson, J. T.** Relationships and trends in hominid evolution, *in* Time and stratigraphy in the evolution of man—NAS-NRC, Div. Earth Sci., Symposium, Washington, D. C., 1965: Natl. Acad. Sci.-Natl. Research Council Pub. 1469, p. 22-29, illus., 1967.

The author summarizes his interpretations of the evidence in hominid evolution, and indicates the areas in which new dating would assist in interpretation. He concludes from study of the australopithecines that (1) true man, of the genus *Homo* sprang from an australopithecine ancestor; and (2) the switch mechanism that shunted the lineage of man off in a new direction leading to the establishment of culture as an important basis of adaptation, was a change from primarily herbivorous to omnivorous diet. On the basis of these conclusions, there are only two primary lineages in the hominid group. The first and more primitive is *Paranthropus*, an australopithecine which died out in the Middle Pleistocene. The second lineage is that of *Australopithecus-Homo*, the *Homo* portion of which has continued to the present.—MST

Romberger, S. B. *See* Barnes, H. L. 04731

04655 **Rowe, M. W.** Cosmic ray spallation and the special anomaly in achondrites: Earth and Planetary Sci. Letters, v. 2, no. 2, p. 92-98, illus., tables, 1967.

The isotopic composition of xenon from achondrites reveals that Xe-124, Xe-126, Xe-128 and Xe-130 are linearly correlated indicating only two principal components for these isotopes—trapped and cosmic ray produced xenon. No evidence is found for the reaction I-127$(n,\gamma\beta)$ Xe-128 in achondrites, thus placing approximate limits on neutron flux relative to flux in Abee chondrite. A correlation in the plot of Xe-124/Xe-130 versus Xe-129/Xe-130 points to a Xe-129/Xe-126 ratio of ≤ 0.84 in xenon from cosmic ray spallation and sets a lower limit on the amount of

radiogenic Xe–129 from decay of extinct I–129 in achondrites. The average value of $\geq 4.4 \times 10^{-12} cm^3/g$ excess I–129 for achondrites contrasts with typical values of about 10^{-10} cm^3/g for ordinary chondrites and about 10^{-9} cm^3/g for enstatite chondrites.—*from* Author's abstract

Rowe, M. W. *See* Funk, H. 04671

04842 **Rowe, Royal C.** Turquoise, gem of antiquity: Gems and Minerals, no. 363, p. 16–17, 45–47, illus., 1967.

In the United States, turquoise is found only in arid or desert regions, a secondary mineral in basic igneous dikes. In New Mexico, its earliest use is believed to date from 450 to 750 A.D. The Cerillos district near Santa Fe was a source of turquoise for the Aztec Indians of Mexico, and has produced a larger proportion of high-grade material than any other United States deposit. The largest single nugget ever discovered came from Battle Mountain, Nevada; it weighed 178 pounds, was 36×25×10 inches in size, and was of good quality and color.—GDC

Rubin, Meyer. *See* Pecora, William T. 04649

04348 **Ruhe, Robert V.; Cady, John G.** The relation of Pleistocene geology and soils between Bentley and Adair in southwestern Iowa—Chap. 1 *in* Landscape evolution and soil formation in southwestern Iowa: U.S. Dept. Agriculture Tech. Bull. 1349, p. 1–92, illus., tables, 1967.

Pleistocene stratigraphy in the area includes Nebraskan till, Aftonian clay, Kansan till, Yarmouth clay, and Loveland and Wisconsin loess. Proportions of nonopaque heavy minerals in samples from most of these are given, although most are from the Sangamon soil profile in the Loveland loess. Cross sections and measured sections are included. Weathering zones in Wisconsin loess, and its characteristics and distribution, faunal zones, and age are discussed. There are four major geomorphic surfaces: the Yarmouth–Sangamon; Sangamon; Late Sangamon; and Wisconsin complex. Each is described in detail, and the paleosols compared with modern soils. The relationship of Pleistocene stratigraphy and geomorphology to soils is discussed by surfaces.—ESL

04349 **Ruhe, Robert V.** Geomorphology of parts of the Greenfield quadrangle, Adair County, Iowa—Chap. 2 *in* Landscape evolution and soil formation in southwestern Iowa: U.S. Dept. Agriculture Tech. Bull. 1349, p. 93–161, illus., tables, 1967.

The South and North Turkey Creek areas were selected for detailed study. The same sequence of tills as in Adair occurs here, the Nebraskan and Kansan tills separated by the Aftonian paleosol. Wisconsin loess mantles the upland divides, but along interfluves occurs more often as outliers on stepped sequences of surfaces; weathering zonation in this loess is described. The Yarmouth–Sangamon paleosols, indicative of the geomorphic surface, are readily identified. The Late Sangamon erosion surface forms a pediment, concave upward, which is marked by a stone line on Kansan till; volumes of sediment removed to form this surface are found as valley fill. Early Wisconsin and late Wisconsin–Recent complex are the other surfaces. Sedimentation and paleosols are described on all surfaces and measured sections given. Soil formation and resurrection of paleosolic surfaces are examined.—ESL

04467 **Russell, Loris S.** Unionidae from the Cretaceous and Tertiary of Alberta and Montana: Jour. Paleontology, v. 41, no. 5, p. 1116–1120, illus., 1967.

"Unio" natosini McLearn from the Lower Cretaceous is redescribed and referred to *Tritogonia* Agassiz. *"Unio" mclearni* Dyer from the Upper Cretaceous is assigned to *Proparreysia* Pilsbry. Three new species are described: *Proparreysia? siberlingi* from the Upper Cretaceous, *Pleurobema dyeri* from the Paleocene, and *Anodonta cypressensis* from the Oligocene.—Author's abstract

Russell, R. D. *See* Currie, R. G. 04665

04490 **Ryder, Robert T.** Lithosomes in the Beaverhead Formation, Montana-Idaho, *in* Centennial basin of southwest Montana—Montana Geol. Soc., 18th Ann. Field Conf. 1967, Guidebook: [Billings, Mont.] Montana Geol. Soc., p. 63–70, illus., 1967.

The formation is a thick sequence of conglomerate, sandstone, siltstone, and limestone more than 15,000 feet thick. Eleven distinct lithosomes recognized and mapped are fundamentaliy of four types: quartz conglomerate, limestone conglomerate, sandstones, and limestone-siltstone units. Several source areas are evident, and the formation is synorogenic as different directional properties and unconformities exist, though each lithosome has consistent directional properties. Deposition began in early Late Cretaceous; the formation rests on Cretaceous rocks unconformably, but has Laramide structural trends, and is overlain by at least Eocene rocks which do not have Laramide trends. A Late Cretaceous to Paleocene age is suggested by fresh-water gastropods and by palynological studies.—HRC

04323 **Saidova, H. M.** Sediment stratigraphy and paleogeography of the Pacific Ocean by benthonic foraminifera during the Quaternary, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 143–151, illus., 1967.

Distribution of benthonic Foraminifera in Quaternary sediments in the North Pacific Ocean has been analyzed from 76 cores (1–12 m long, taken at 2–8 km depths), in comparison with present distribution of the same species. Two living faunas are distinguished: 'secretion' fauna, at depths down to 3.5–4.5 km, divided into three taxocoenoses and 29 genocoenoses; 'agglutinate' fauna, at depths exceeding that, representing one taxocoenosis. During late Quaternary, latitudinal or climatic distribution deeper than 1.5–2 km did not differ from the present, but vertical (depth, pressure) distribution shows gradual replacement of shallow-water forms in the Wisconsin horizon by deep-water forms in the Holocene. Faunal replacement occurred mainly on the ocean floor adjacent to continents, island arcs, and ridges, but not in areas remote from these points; this is explainable only by depth increase due to local tectonic movement.—VMJ

04353 **Sainsbury, C. L.** Upper Pleistocene features in the Bering Strait area, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D203–D213, illus., table, 1967.

New data on upper Pleistocene deposits east of Bering Strait may solve some problems of correlation. Erratics (Skull Creek erratics) of a widespread pre-Wisconsin glaciation are now recognized; the east limit of the early Wisconsin York Glaciation is defined, as is the northwest limit of Wisconsin glaciers from the Kigluaik Mountains. An anomalous glacial pattern is shown for two adjacent ranges (York and Kigluaik Mountains) and existing glacial correlations are refined. The barrier bar along the northwest coast of Seward Peninsula is migrating landward rapidly. Local destruction of marine terraces of Yarmouth(?) and Sangamon age can be explained by glaciation and dune migration.—Author's abstract

04681 **Saint-Julien, Pierre.** Tectonics of part of the Appalachian region of southeastern Québec (southwest of the Chaudière River), *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 41–47, illus., 1967.

The Appalachians in southeastern Quebec are underlain by Cambrian to Middle Devonian rocks in five northeasterly trending belts; these are, from northwest to southeast, the Sutton-Bennett belt, Serpentine belt, Saint-Victor synclinorium, Stoke Mountain belt, Gaspé-Connecticut Valley synclinorium. These divisions are based mainly on tectonics but also on rock types and ages. The rocks are mainly metasedimentary; metavolcanic and intrusive rocks are common but less widespread. Fold patterns and systems are described and stratigraphy is briefly summarized for each belt. The Gaspé-Connecticut Valley synclinorium and the Stoke Mountain belt have been thrust northwestward over the Saint-Victor synclinorium.—VMJ

04593 **Sandberg, Charles A.** Exshaw Formation of Devonian and Mississippian age in northwestern Montana, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1966: U.S. Geol. Survey Bull. 1254-A, p. A39–A41, illus., 1967.

04298 **Sando, William J.** Mississippian depositional provinces in the northern Cordilleran region, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D29-D38, illus., 1967.

Biostratigraphic studies permit recognition of the Wyoming, Montana, and Idaho depositional provinces in the Mississippian System of the northern Cordilleran region. Mississippian rocks record two major marine transgressions separated by a widespread episode of epeirogenic emergence. The earlier, or Madison, transgression began in latest Devonian time and pulsated eastward over a broad cratonic shelf. The Madison sea gradually shallowed from Osage to early Meramec time and withdrew during early or middle Meramec. During later Meramec and Chester time, the sea returned, and the region was differentiated into a miogeosynclinal belt and a cratonic platform. Deposition continued uninterruptedly into the Pennsylvanian except in an emergent area that developed in southeasternmost Idaho and westernmost Wyoming during latest Mississippian or earliest Pennsylvania time.—*from* Author's abstract

04454 **Sando, William J.** A technique for studying early ontogeny in solitary rugose corals: Jour. Paleontology, v. 41, no. 5, p. 1291-1293, 1967.

Difficulties encountered in serial study of early ontogeny in solitary rugose corals are largely overcome by a technique that permits grinding, observation, and recording of pertinent details, starting at a mature growth stage and proceeding toward the tip of the corallum. Application of mounting and replication methods recently devised by bryozoan specialists affords a practical solution to problems of serial growth study in corals. A mounting technique using a plug of polyester resin and a replication technique employing cellulose acetate blanks are described in detail.—Author's abstract

04481 **Sass, Daniel B.** Electron microscopy, punctae and the brachiopod genus *Syringothyris* Winchell, 1863: Jour. Paleontology, v. 41, no. 5, p. 1242-1246, illus., 1967.

A careful examination of 11 specimens, representing 6 species, one supposedly impunctate, revealed the presence of punctae in every case despite relatively severe post-depositional alteration in some material. Data assembled herein indicate that, contrary to previous evidence, all species properly assigned to the genus *Syringothyris* Winchell, 1863 are probably endopunctate.—*from* Author's abstract

Schaeffer, O. A. *See* Funkhouser, J. 04668

04574 **Schairer, J. F.** Phase-equilibria at one atmosphere related to tholeiitic and alkali basalts, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 568-592, illus., 1967.

The simplified basalt tetrahedron is described and illustrated, and an exploded view given; phase diagrams for systems forming its faces are shown and discussed. Description of phase-equilibrium relations in quaternary systems is simplified by flow sheets for the siliceous portion, quartz normative with anorthite instead of albite, and the nepheline normative portion. An expanded basalt tetrahedron, having the same base, but with larnite at the apex, is used to enlarge the scope of the chemistry. Six planes in the tetrahedron are studied; diagrams of the joins, and a flow sheet for a major portion are shown. A corresponding rock nomenclature diagram is included. Alkali rocks related to basalts are examined also.—ESL

04313 **Scheidegger, A. E.** A thermodynamic analogy for meander systems: Water Resources Research, v. 3, no. 4, p. 1041-1046, illus., 1967.

A thermodynamic analogy for meander systems can be set up such that analogs of temperature, entropy, free-energy can be defined, based on the statistical aspects of meander formation.—Author's abstract

04613 **Schiff, Anshel Judd.** Some problems in engineering seismology [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 709B, 1967.

Schilling, John H. *See* Garside, Larry J. 04715

Schlocker, Julius. *See* Mullineaux, Donal R. 04389

Schmitt, Roman A. *See* Haskin, Larry A. 04597

Schnetzler, C. C. *See* Philpotts, John A. 04661

Schoellhamer, J. E. *See* McCulloh, T. H. 04351

Schoellhamer, J. E. *See* McCulloh, T. H. 04352

04493 **Scholten, Robert.** Structural framework and oil potential of extreme southwestern Montana, *in* Centennial basin of southwest Montana—Montana Geol. Soc., 18th Ann. Field Conf. 1967, Guidebook: [Billings, Mont.] Montana Geol. Soc., p. 7–19, illus., 1967.

The area is located on the edge of the shelf of the North American craton, the hinge of the miogeosyncline occurring immediately to the west. The gross structures of the region, a result of Laramide deformation, show several major anticlinoria or arches involving Precambrian basement radiating southward from a central domal uplift, the Tobacco Root Mountains, and are primarily from vertical movement. At the western edge, the structural trends are toward the northwest, the result of compressional forces in the miogeosyncline. The cratonic movement occurred first, beginning in the Middle or Upper Cretaceous, depositing the Beaverhead Conglomerate as synorogenic which was later deformed by the miogeosynclinal tectonism. Both continued to the Eocene. The oil potential is grim.—HRC

04390 **Schopf, Thomas J. M.** Bottom-water temperatures on the continental shelf off New England, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D192–D197, illus., table, 1967.

Approximately 5,300 measurements of bottom-water temperatures collected on cruises of U.S. Bureau of Commercial Fisheries vessels, mostly in 1955, 1956, 1964, and 1965, show a striking similarity of bottom temperatures on Georges Bank and Nantucket Shoals, and distinctly lower temperatures on the nearby Scotian Shelf. An intermediate temperature regime occurs in the Gulf of Maine. Temperature distribution is related to bottom currents that circulate water over the Scotian Shelf, through the Gulf of Maine, and then onto Georges Bank and Nantucket Shoals. Available data indicate that regions of different bottom-temperature regimes have different faunal assemblages.—Author's abstract

04471 **Schopf, Thomas J. M.; Manheim, Frank T.** Chemical composition of Ectoprocta (Bryozoa): Jour. Paleontology, v. 41, no. 5, p. 1197–1225, illus., tables, 1967.

Combined ignition loss and spectrochemical techniques were used to analyze 28 samples, distributed among 13 species of ectoprocts, for organic matter, CO_2, calcium, magnesium, strontium, barium, phosphorus, and iron. The new data are generally in good agreement with those of Clarke and Wheeler (1922) who supplied the only appreciable body of previous information on major elemental composition of ectoprocts.—RCD

04871 **Schopf, Thomas J. M.** The literature of the Phylum Ectoprocta—1555–1963: Systematic Zoology, v. 16, no. 4, p. 318–327, illus., 1967.

Numbers of papers, subjects discussed, and major workers on the phylum were compiled from the literature. The average yearly number of papers on ectoprocts [Bryozoa] increased greatly throughout the 19th century. Approximately 5,500 papers have been written on the phylum, of which about 3,600 deal with systematics and other biologic topics; the remainder are on the use of ectoprocts in ecologic or stratigraphic studies. No catalog of the literature has been prepared since 1900, and a modern Catalog of Ectoprocta, cross-indexed to taxonomic names and subjects, would lead to greatly increased interest and work on these animals.—*from* Author's abstract

Schroeder, Marvin L. *See* Albee, Howard F. 04302

Schrott, R. O. *See* Burchett, R. R. 04755

04317 **Sears, M.** (editor). Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, 344 p., illus., tables, 1967.

This symposium was arranged by Bruce C. Heezen for the 7th Congress of the Internatinal Association for Quaternary Research, Boulder, Colorado, 1965. Papers are grouped into: Plio-Pleistocene boundary, polar seas, temperate seas (paleontology and geochemistry), and Quaternary sea level. Of the 21 papers, 14 are cited separately.—MCM

Seed, H. Bolton. *See* Lee, Kenneth L. 04308

Seed, H. Bolton. *See* Duncan, James M. 04320

Seed, H. Bolton. *See* Lee, Kenneth L. 04321

Seed, H. Bolton. *See* Duncan, J. M. 04411

04786 **Seeger, Charles Ronald.** Origin of the Jeptha Knob structure, Kentucky [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 951B, 1967.

04561 **Segal, Ronald Henry.** A study of certain cardiocarpalean ovules from the American Carboniferous [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 804B–805B, 1967.

04846 **Seigel, Harold O.** Radiometric instruments assay for prospectors: Northern Miner, v. 53, no. 36(1141), p. 49, 62, illus., 1967.

The current year has seen an acceleration of the search for uranium in Canada. Because uranium is radioactive, it is usually detected by an instrument. In the earlier phase of exploration, the Geiger-Muller tube was the most commonly employed; use of scintillators began in the early 1950's. Today almost all serious uranium exploration employs gamma-ray spectrometers. The instrument can be used in the air, on the ground, or in drill holes; spectrograms for potassium, uranium, and thorium show how the gamma radiation is resolved. Two basic types of spectrometers are Integral and Differential. A profile over a uranium deposit in Texas is shown.—ESL

Seiglie, George A. *See* Bermudez, Pedro J. 04418

04414 **Sever, Charles W.; Cathcart, James B.; Patterson, Sam H.** South Georgia Minerals Program—Proj. Rept. 7, Phosphate deposits of south-central Georgia and north-central peninsular Florida: Atlanta, Ga., Georgia Dept. Mines, Mining and Geology, 62 p., illus., tables, 1967.

This discussion of Tertiary stratigraphy and associated phosphate deposits includes a detailed description of Miocene strata, particularly the four zones of the "Hawthorn Formation". Miocene marine beds overlying the Hawthorn are here called Duplin Marl equivalents; unnamed clastics in southwestern Georgia may be a nonmarine facies of these beds. Structures in the area are reviewed. Phosphate deposits are scattered throughout a large area, the best being in early and middle Miocene beds, but valuable phosphate may also occur in late Miocene clastics. The phosphate is chiefly the pebble type, mostly pellets in sand; carbonate-fluorapatite is the only phosphate mineral found. Phosphate may have formed in local basins or estuaries, northeast or east of broad low anticlines.—ESL

Shaffer, F. Butler. *See* Souders, Vernon L. 04759

04358 **Shapiro, Leonard.** A simple and rapid indirect determination of fluorine in minerals and rocks, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D233-D235, tables, 1967.

Fluorine is volatilized from a 5-milligram sample in a test tube as H_2SiF_6, using phosphoric acid to decompose the sample. The upper part of the test tube is washed with dilute hydrochloric acid, and the silica in the wash liquid is determined spectrophotometrically as molybdenum blue. With suitable standards, and samples with less than five percent F, accuracy is generally ±5 percent relative or ±0.05 percent absolute, whichever is larger.—Author's abstract

04844 **Sharp, Robert P.** Speculations about the earth, *in* Scientific progress and human values—Conf., California Inst. Technology, 75th Anniversary, Pasadena, 1966, Proc.: New York, American Elsevier Publishing Co., p. 27–46, illus., 1967.

Any possible remnant of primodial crust of the Earth appears altered beyond identity as a result of meteoroidal impacts, speculated to have been regularly spaced in relation to size with perhaps 50,000 giant bodies in the last 500 million years. Effects include scars—Meteor and New Quebec Craters, Ries Basin, and Vredefort Ring—and chain reactions such as outgassing, crustal deformation, igneous phenomena, devastating sea waves, climatic perturbations, oxygen depletion, extinction of fauna and flora, earthquakes, and alteration of axial rotation. Interior and circumterrestrial environments are uniquely differentiated; behavior of earthquake waves, free oscillations, earth tides, and magnetic field suggest deep mobility and causes of instability in the western United States, Pacific Coast, and southern California.—GDC

04832 **Shaw, Charles E., Jr.; Petersen, Richard G.** Surficial geologic map of the Hanover quadrangle, Plymouth County, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-633, scale 1:24,000, text, 1967.

The Hanover quadrangle is underlain by Pennsylvanian sedimentary rocks and pre-Pennsylvanian granitic gneisses, the former nonconformably overlying the latter. Inset maps show generalized bedrock geology and generalized contours on bedrock surface beneath cover of glacial deposits. Surficial deposits are divided into 13 time-stratigraphic units, with Recent deposits further subdivided on the basis of materials and topography. Units 1–7a, stratified sand and gravel deposits, were laid down by glacial melt waters as the ice retreated. Ice blocks buried in a deep preglacial valley formed depressions now occupied by the several lakes in the western half of the quadrangle.—MCM

04577 **Shaw, Herbert R.** Hydrogen osmosis in hydrothermal experiments, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 521–541, illus., 1967.

Interpretation of mineral stabilities in the Earth has involved increasing attention to theoretical application and experimental control of chemical potentials besides temperature and pressure. Shaw (1963) devised a method for controlling hydrogen fugacity directly. Two systems are brought together, separated only by a membrane permeable to one component. A net transfer will take place until osmotic equilibrium is reached. This principle is discussed, and the apparatus described and illustrated. Sections are devoted to determining the fugacities and sample computations. An appendix describes attempts to define and give physical explanations for fugacity.—ESL

04639 **Shaw, Nolan Gail.** Cheilostomata of the Gulfian Cretaceous of southwestern Arkansas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 1, p. 236B, 1967.

04332 **Shepard, F. P.; Curray, J. R.** Carbon-14 determination of sea level changes in stable areas, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 283–291, illus., 1967.

Evidence is reviewed for and against sea-level rise, above present level, at several times during the Holocene. In stable areas, as Netherlands coast and southern Florida, C-14 dates on peat show continuous gentle rise of sea level from 7000 to 2000 yr B.P., approaching the present level. C-14 dates from Gulf coast and Atlantic coast south of glaciation show sea level rising at a diminishing rate during the past 6000 years, though subsidence may be a factor. None of these curves

match Fairbridge's (1961) oscillating curve plotted from C-14 dates on shells from presumed Holocene terraces in Australia and oceanic islands; many such dates may not be reliable, as the shells may differ in age from the terraces. C-14 dates from Hawaiian terraces, 7500 to >50,000 yr B.P., did not indicate postglacial high sea levels. There is historical evidence of slight sea-level rise in Europe between 200 and 900 A.D.—VMJ

04752 **Shotwell, J. Arnold.** Late Tertiary geomyoid rodents of Oregon: Oregon Univ. Mus. Nat. History Bull. 9, 51 p., illus., tables, 1967.

The geomyoid rodents of the late Tertiary of Oregon are described and their relationships discussed. Most of the material involved is new. A new genus, *Parapliosaccomys*, is recognized and three new species, *Parapliosaccomy oregonensis*, *Adjidaumonquartzi*, and *Pseudotheridomys pagei*.—Author's abstract

04422 **Sieck, Herman.** Continuous seismic profiling—Growth of marine mining hinges on data available: Ocean Industry, v. 2, no. 1, p. 1A-7A, illus., 1967.

Continuous seismic profiling in marine areas involves the development and application of sonar-type systems to gathering bottom and subbottom information. The principal of sonar is explained, of which the echo sounder is an extension. Four functional elements are: a sounder or transducer, an energy source, a receiver, and a recorder; and on large bodies of water some positioning system is needed. Magnetometers and gravimeters are operated simultaneously, and samples taken. Three types of systems are described: Pinger probe, Boomer, and Sparkarray.—ESL

Sim, K. Y. *See* Geissman, T. A. 04843

04688 **Simonett, David S.** Possible geographic research with orbiting radars—A review of recent studies [abs.]: Assoc. Am. Geographers Annals, v. 57, no. 4, p. 804, 1967.

04823 **Simons, E. L.** Unraveling the age of earth and man: Nat. History, v. 76, no. 2, p. 52-59, illus., 1967.

Early estimates of the age of the Earth and methods of calculating it are reviewed. Dating by fossils left no way of estimating time during unconformities, and Kelvin's method, based on cooling of the Earth, did not allow for radioactive heat. Isotope methods are the most accurate technique. Zircons at least 3,300 million years old have been dated in North America, but the U-Pb age of meteorites is 4,500 million years. Primates were found in the middle Pleistocene in North America, and a tooth was reported from latest Mesozoic, 63-66 m.y. ago. Prosimians were widespread in the early Tertiary, followed by development of Anthropoidea. First fossil apes were early Oligocene; oldest relative of man was the Miocene-Pliocene genus *Ramapithecus*. First stone-age men were early Pleistocene; *Pithecanthropus*, 500,000 yr B.P., was the next important stage.—ESL

04669 **Simpson, John F.** Stylolites and continental drift: Earth and Planetary Sci. Letters, v. 2, no. 3, p. 191-192, illus., 1967.

An analogy is suggested between stylolites and transform faults, both originating from slight differences in strength on opposite sides of converging masses. Accumulation of insoluble residue along stylite seams may be likened to accumulation of sialic material, which cannot be reabsorbed by the mantle, along contacts of drifting continental blocks, thus accounting for the andesitic character of volcanism in these areas.—VSN

04826 **Sinclair, A. J.** Trend-surface analysis of minor elements in sulfides of the Slocan mining camp, British Columbia, Canada: Econ. Geology, v. 62, no. 8, p. 1095-1101, illus., table, 1967.

Second-order trend surface and residual maps were prepared for Ag in galena, Sn in sphalerite, and As in pyrite. Quadratic surfaces for all three variables show a similar dome and northwest elongation, perhaps reflecting a relatively high temperature center of mineralization near Sandon camp.—WSW

04841 **Sinkankas, John.** Notes on some minerals from San Diego County, California: Gems and Minerals, no. 363, p. 34–35, illus., 1967.

Among the minerals briefly described from the Ramona pegmatite district are laumontite, bismuthinite, epidote, axinite, albite and microcline, and green tourmaline. Some are new to the area, some unusual; their occurrences were in near-surface pockets associated with euhedral perthite, which also contained quartz crystals and black tourmaline. Spessartine garnet specimens found were small and too dark to be cut. Throughout much of the length of the Hercules pegmatite there is graphic granite which has been leached of quartz rods, the cavities filled with clay.—GDC

Skibitzke, H. E. *See* Robinove, C. J. 04384

04679 **Skidmore, W. B.** The Taconic unconformity in the Gaspé Peninsula and neighbouring regions, *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 25–32, illus., 1967.

The Gaspé–Connecticut Valley synclinorium forms at its northeast end the central Silurian–Devonian belt of the Gaspé Peninsula, bordered on both sides by Cambro-Ordovician rocks. A Taconic unconformity is clearly present along the north side, where a gap in the sedimentary record embraces at least the whole of the Upper Ordovician; but on the south side accumulating palaeontological evidence suggests generally continuous sedimentation from Middle Ordovician to Early Devonian, the gap being filled by limestones of Late Ordovician to Silurian age, which can be traced along an anticlinorial belt southwestward into northeastern Maine. Southeast of the anticlinorium, near Chaleurs Bay, an Upper Ordovician unconformity is again evident.—*from* Author's abstract

Skippen, George B. *See* Eugster, Hans P. 04576

04787 **Skippen, George Barber.** An experimental study of the metamorphism of siliceous carbonate rocks [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 951B–952B, 1967.

04314 **Smart, J. S.; Surkan, A. J.** The relation between mainstream length and area in drainage basins: Water Resources Research, v. 3, no. 4, p. 963–974, illus., tables, 1967.

In the equation $L' = CA^{n'}$, representing data on mainstream lengths and basin areas, Hack (1957) has suggested that the deviation of n' from 1/2 can be explained by an elongation of drainage basin shapes with increasing area. In this paper it is pointed out that variations of stream sinuosity with area can also affect the value of n'. A simple approximate formula is deduced that relates mainstream length, sinuosity, basin shape, and area, and shows how the contributions of sinuosity and shape variation to the quantity $(n' - 1/2)$ may be separated and evaluated, illustrated with data for both real and simulated stream systems. Parameters and variations are tabulated for Bailey Run, Pa., and Big Indian Hollow, N. Y. The mainstream length does not appear to be a very useful parameter in characterizing drainage basins.—GDC

Smith, C. H. *See* Irvine, T. N. 04501

Smith, Clay T. *See* Read, Charles B. 04631

04753 **Smith, J. Hiram.** Geologic map of the Rockholds quadrangle, Whitley and Knox Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–677, scale 1:24,000, section, text, 1967.

Coal, natural gas, and petroleum are the commercially important mineral resources of the Rockholds quadrangle. The Jellico, Blue Gem, Fire Clay, and Fire Clay rider coal beds produce banded, bituminous rank coal; average thickness of the Jellico is about 30 inches and of the Blue Gem 20 inches. Oil and natural gas are produced in small quantities; gas is from the Late Mississippian Newman

Limestone at a depth from 1,400–1,600 feet. Oil production is small, the producing horizon probably being the Rockcastle Conglomerate Member of the Early Pennsylvanian Lee Formation.—MCM

04393 **Smith, James W.; Pickering, Samuel M., Jr.; Landrum, J. Roger.** South Georgia Minerals Program—Proj. Rept. 8, Heavy-mineral-bearing sand of the coastal region of Georgia: Atlanta, Ga., Georgia Dept. Mines, Mining and Geology, 68 p., illus., tables, 1967.

Since the area of sand, similar to that mined near Folkston, is covered by more recent sand, 80 holes were augered to about 8 feet. Percentages by weight of grain-sizes were determined, light and heavy fractions separated, and percentages of titanium minerals determined by counting grains. Titanium and zirconium were determined by wet chemical analysis, and monazite content by radiometry. Large areas of heavy-mineral concentrations occur at Folkston, Cumberland Island, Jekyll Island, and near Woodbine and Brunswick. Samples containing more than two percent heavy minerals were also augered at several places. No Pleistocene sand with more than one percent heavy minerals was found west of Trail Ridge. Higher level Pleistocene sands are leached of undesirable species and the titanium minerals of iron, and thus may be of greater economic interest.—ESL

04350 **Smith, Peter J.** Ancient geomagnetic field intensities—[Pt.] 1, Historical and archaeological data, sets Hi–H9: Royal Astron. Soc. Geophys. Jour., v. 13, no. 4, p. 417–419, table, 1967.

Worldwide data on ancient geomagnetic field intensities covering the historic and archeological time scales, available to December 1966, are compiled in a table.—DBV

04453 **Smith, Roberta K.** Ignition and filter methods of concentrating shelled organisms: Jour. Paleontology, v. 41, no. 5, p. 1288–1291, tables, 1967.

Comparison and evaluation of ignition, common or classical, and filter methods of preparing plankton samples for study of shelled organisms reveals that, in most cases, shells are best concentrated by the ignition method. The filter method, advocated by Boltovskoy, simply extends the classical method to drying the samples, thus reducing the volumes which must be examined. In the ignition method aliquots of samples are processed as follows: 1) formalin removed; 2) soft organic matter digested; 3) digesting agent removed; 4) dried; 5) ignited; 6) rinsed to remove ash; 7) examined by randomly selected rectangles in a picking tray to estimate the numbers of specimens and relative abundances of species.—Author's abstract

04635 **Smith, Samuel Joseph.** Susceptibility of interlayer potassium in illites to exchange [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 1, p. 19B–20B, 1967.

04685 **Smith, W. E. T.** Some geological and tectonic considerations of eastern Canadian earthquakes, *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 84–93, illus., table, 1967.

About 1,500 earthquakes are known to have occurred in eastern Canada and adjacent areas. Their epicentres and magnitudes are currently being used as a basis for the preparation of maps from which seismic hazard may be estimated region by region. Isoseismal maps can be used to show the broad outlines of areas of differing stability but not to draw detailed geological conclusions. The Grand Banks earthquake afforded an excellent example of submarine transport of large masses of materials over great distances. No apparent correlation either in space or time could be found between earthquakes and faults.—Author's abstract

Sneed, Paul G. *See* Swanson, Earl H., Jr. 04702

04703 **Sneed, Paul G.** An archaeological reconnaissance of the Craters of the Moon National Monument: Tebiwa, v. 10, no. 1, p. 37–52, illus., 1967.

Twenty-eight sites are located and artifacts described and illustrated. It is clear

that the Indians did not, tradition notwithstanding, shun this volcanic area. The artifacts are similar to those found in Birch Creek valley to the north, stratigraphically late in time.—HRC

Soga, Naohiro. *See* Anderson, Orson L. 04346

04372 **Soister, Paul E.** Relation of Nussbaum Alluvium (Pleistocene) to the Ogallala Formation (Pliocene) and to the Platte–Arkansas Divide, southern Denver Basin, Colorado, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D39–D46, illus., 1967.

Alluvial sand and gravel deposits about 145 feet thick and assignable to the Nussbaum Alluvium lie on an erosion surface that slopes southward toward the Arkansas River from near the Platte–Arkansas divide. The arkosic Dawson Formation was the main sediment source. The Nussbaum is partly overlapped by similar younger alluvial deposits. Local post–Nussbaum shifts of the divide are indicated by some deposits on it. Near the divide, the Ogallala Formation may have been overlapped by the Nussbaum. Restored contours on the base of the two formations indicate that the pre–Nussbaum surface diverged from about the same altitude as the pre–Ogallala surface near the divide to several hundred feet below the pre–Ogallala surface near the present Arkansas River.—Author's abstract

04526 **Sörensen, Henning.** Metamorphic and metasomatic processes in the formation of ultramafic rocks, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 204–212, illus., 1967.

Ultramafic bodies are conformably enclosed by highly deformed crystalline schists, especially amphibolites and hornblende gneisses; numerous examples are described. Some of the smaller bodies are clearly metasomatic and/or metamorphic. Metasomatism of siliceous dolomite yields the dolomite–serpentinite association, and the dolomite–peridotite association could result from the metamorphic replacement of impure carbonates in high-pressure zones. Peridotite and garnet-peridotite, when enclosed in amphibolite, are products of metamorphic differentiation in zones of stress concentration. Many examples come from western Greenland.—HRC

04759 **Souders, Vernon L.; Shaffer, F. Butler.** Water sources of Antelope County, Nebraska [abs.]: Nebraska Acad. Sci. Proc., 77th Ann. Mtg., p. 18–19, 1967.

04624 **Spielberg, N.** Characteristics of flow proportional counters for X-rays, *in* Advances in X-ray analysis, V. 10—Applications of X-ray analysis, 15th Annual Conf., Univ. Denver, 1966, Proc.: New York, Plenum Press, p. 534–545, illus., tables, 1967.

For most effective use of gas-flow proportional counters for detection of soft X-rays (and of sealed proportional counters as well) it is necessary to have a clear understanding of the effect of various design parameters and operating conditions on their performance. The dependence of shape of pulse height distribution on operating voltage, pressure and counting rate is described as a function of energy of radiation detected and nature of the gas. Stability requirements on counter tube high voltage supplies and operating pressure are discussed. Shifts of pulse height distributions toward smaller pulse sizes with increasing counting rate are described and dependence of these shifts on various parameters and on wavelength are discussed. Techniques for eliminating shifts and implications of these techniques for associated electronics are described.—Author's abstract

04699 **Srivastava, Satish K.** Upper Cretaceous palynology—A review: Bot. Rev., v. 33, no. 3, p. 260–288, tables, 1967.

A review is given, without any new information being added, of microspore assemblages from the Upper Cretaceous rocks of the world. Genera and species are listed from various localities, with a summary of each author's interpretation. The same treatment is allotted to megaspores and other plant microfossils, on which relatively little work has been done. Microplankton and diatoms are mentioned also. Five prospects for Upper Cretaceous palynology are given, each a summary of a previously-published interpretation or suggestion.—HRC

04883 **Srivastava, Satish K.** Palynology of Late Cretaceous mammal beds, Scollard, Alberta (Canada): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 3, no. 1, p. 133–150, illus., 1967.

Mammal-bearing Upper Edmonton Beds above the Kneehills Tuff and samples from above and below, in the Scollard area, were analyzed for palynological contents. Microflora representing pteridophytes, gymnosperms, and angiosperms were recorded with an abundance of *Aquila pollenites* of morphological diversity. The assemblages showed five paleoecological stages: (1) the lowest, mid-Middle Edmonton, swampy, tropical and humid; (2) cooler stages; (3) further cooling caused by volcanic dust, as bentonite content of Kneehills Tuff is high and pollen and spores poorly preserved in finely comminuted fragments; (4) warming but still cool; (5) rich woodland, mid-Upper Edmonton, subtropical with warm temperate aspect. Stratigraphic positions of the samples studied and listed species are illustrated. GDC

04848 **Štelcl, Otakar; Panoš, Vladimír.** Výzkum krasu kubánských mizin [with English abs.]: Československá Akad. Věd. Geog. Ústavu Zpravy 1967, no. 2, p. 1–4, illus., 1967.

The results are given of karst exploration carried out in the western Cuban plains in 1964–65. These plains contain regions of concentrated sugar cane, tobacco, and fruit cultivation, as well as cattle raising. The more serious problems involved a water supply to irrigate the plantations, the penetration of salt water into underground supplies in the karst areas, and erosion connected with intense karstification. Exploration was carried out by means of synoptical geomorphologic mapping on a scale of 1:100,000.—*from* Authors' English abstract

Stemprok, M. *See* Barnes, H. L. 04731

04545 **Stephens, Fred H.** Utica Mines, Canada's newest silver producer: Western Miner, v. 40, no. 8, p. 39–41, illus., 1967.

Silver-bearing quartz-calcite veins of the Utica Mines area, British Columbia, are in a mafic monzonite phase of the Kruger syenite of Jurassic age. Veins contain argentite, galena, sphalerite, and chalcopyrite. Ore contains 20.2 ounces of silver and 0.053 ounces of gold.—ARK

Stern, T. W. *See* Zartman, R. E. 04386

04373 **Steven, Thomas A.; Mehnert, Harold H.; Obradovich, John D.** Age of volcanic activity in the San Juan Mountains, Colorado, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D47–D55, illus., tables, 1967.

The interpretation that volcanic activity in the San Juan Mts. took place mostly during the Miocene and Pliocene requires modification. K-Ar ages of six formations in the central and eastern parts show: (1) The last major intermediate to silicic unit in the San Juans, the Fisher Quartz Latite, was erupted near the end of the Oligocene, about 26 m.y. ago. Similar rocks were erupted locally and in small volume through early Miocene. (2) The Creede Formation, deposited concurrently with Fisher volcanism, is thus latest Oligocene. (3) The span of time between eruption of oldest and youngest units was less than 2 million years. (4) The Hinsdale Formation consists of units erupted during widely separated volcanic episodes, and the concept of a single genetically related formation needs to be modified.—*from* Authors' abstract

04548 **Stevenson, William G.** Mount Washington Copper Co. Ltd.—Geologic conception as porphyry copper deposit: Western Miner, v. 40, no. 11, p. 35–38, 40, illus., 1967.

Widely distributed copper mineralization suggests that the environment is favorable for a disseminated copper deposit.—ARK

04374 **Stewart, John H.; Palmer, Allison R.** Callaghan window—A newly discovered part of the Roberts thrust, Toiyabe Range, Lander County, Nevada, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D56-D63, illus., 1967.

A previously undescribed window in the Roberts thrust, here named the Callaghan window, covers about 40 square miles of the northern part of the Toiyabe Range, 15 miles north of Austin, Nev. A regionally important quartzite, limestone, and shale sequence which is over 10,000 feet thick and of Cambrian, Ordovician, and Silurian age is exposed in the window. Strata above the thrust comprise chert and quartzite probably of Ordovician and Devonian age. The strata in the window are cut by many low- and high-angle faults, and the central part of the window is a north-trending horst.—Authors' abstract

04658 **Stewart, T. Dale.** Chronometric dating and taxonomic relationships, *in* Time and stratigraphy in the evolution of man—NAS-NRC, Div. Earth Sci., Symposium, Washington, D. C., 1965: Natl. Acad. Sci.-Natl. Research Council Pub. 1469, p. 17-21, 1967.

The author discusses the problems of chronometric dating as opposed to morphological or anatomical dating, and taxonomic relationships in human evolution. Chronometric dating has revealed the contemporaneity of specimens that, because of their very different appearance, might otherwise have been assigned to an evolutionary sequence.—MST

04362 **Stoner, J. D.** Prediction of salt-water intrusion in the Duwamish River estuary, King County, Washington, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D253-D255, illus., table, 1967.

Accurate predictions of salt-water intrusion 7.8 miles upstream from the mouth of the Duwamish River can be made for the 3-ft surface layer, using the relationship between tide height and fresh-water discharge. Intrusion occurs at the site regardless of the high-tide height, when discharge is less than 625 cfs, whereas a discharge of 1,000 cfs is sufficient to prevent intrusion at any tide stage. Between 625 and 1,000 cfs, intrusion is dependent upon both discharge and high-tide height. Author's abstract

Strahler, Arthur N. *See* Navarra, John Gabriel. 04440

04657 **Straus, William L., Jr.** Nature of the problem and the evidence, *in* Time and stratigraphy in the evolution of man—NAS-NRC, Div. Earth Sci., Symposium, Washington, D. C., 1965: Natl. Acad. Sci.-Natl. Research Council Pub. 1469, p. 1-17, illus., 1967.

The author presents a brief outline of the known fossil record of human evolution, noting the major problems associated with identification, and poses questions related to the stratigraphy, correlations, and significance of dating. The problems involved in the interpretation of ages of fossils, morphological evolution, and lines of descent are discussed. The importance of precise dating for their solution is emphasized.—MST

04722 **Stroud, Lowell; Meyer, Thomas O.; Emerson, David E.** Isotopic abundance of neon, argon, and nitrogen in natural gases—Relationship to helium genesis: U.S. Bur. Mines Rept. Inv. 6936, 27 p., illus., tables, 1967.

The isotopic abundance of Ne-21 in seven high-helium gases was greater than in the atmosphere, with 33-85 percent excess or radiogenic Ne-21. The ratio of He-4 to Ne-21 (rad) varied from 2.9×10^7 to 5.9×10^7. The ratio of Ar-40 to Ar-36 ranged from 5 to 75 times atmospheric, with 80 to 99 percent of the Ar-40 being radiogenic. The ratio of He-4 to Ar-4 (rad) in the seven high-helium plus three low-helium gases ranged from 4 to 18. The isotopic ratio of N-14 to N-15 in four of the high-helium gases approximated the atmospheric value of 272 and was 5 percent higher in three. The helium in the natural gases is attributed to radioactive decay of uranium and thorium; excess Ne-12 is probably also of radiogenic origin. Methane and nitrogen may result from alpha irradiation of organic compounds.—KFF

04788 **Stuart-Alexander, Désirée Elizabeth.** Contrasting deformation of Paleozoic and Mesozoic rocks near Sierra City, northern Sierra Nevada, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 952B–953B, 1967.

Stueber, Alan M. *See* Murthy, V. Rama. 04522

Surkan, A. J. *See* Smart, J. S. 04314

04465 **Sutherland, Patrick K.; Harlow, Francis H.** Late Pennsylvanian brachiopods from north-central New Mexico: Jour. Paleontology, v. 41, no. 5, p. 1065–1089, illus., table, 1967.

The name Jemez Springs Shale Member is proposed for a 30-to 40-ft shale interval near the top of the Madera Formation which crops out in the San Diego Canyon in north-central New Mexico. This highly fossiliferous unit contains exceptionally well preserved brachiopods that are closely similar to species in the Midcontinent region. Specimens of 18 brachiopod species, representing 17 genera, were collected and about half of these occur commonly. Thirteen Midcontinent species names are tentatively used and two new species are described. The new species are *Aniquatonia jemezensis and Neospirifer pattersoni.* The brachiopod fauna indicates a Virgilian age and suggests a correlation with some part of the Shawnee or lower Wabaunsee Groups in the Midcontinent region.—Authors' abstract

04789 **Suttner, Lee Joseph.** Analysis of the Upper Jurassic–Lower Cretaceous Morrison and Kootenai Formations, southern Montana [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 953B, 1967.

04702 **Swanson, Earl H., Jr.; Sneed, Paul G.** An archaeological reconnaissance of Railroad Ranch in eastern Idaho, 1966: Tebiwa, v. 10, no. 1, p. 53–59, illus., 1967.

Railroad Ranch is part of Island Park and lies along the Henry's Fork of Snake River near Yellowstone Park. Forty-one sites were examined, and artifacts similar to the Birch Creek valley types are described and illustrated. The area near the springs of Thurmon Creek was especially densely inhabited. Most of the artifacts are of obsidian, ignimbrite, and basalt.—HRC

Swindale, L. D. *See* Kimura, Hubert S. 04446

04608 **Swoboda, Allen Ray.** Thermodynamics of cation exchange in montmorillonite clay [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 434B, 1967.

04625 **Szalay, Frederick S.** The affinities of *Apterodon* (Mammalia, Deltatheridia, Hyaenodontidae) [discussion of papers by L. VanValen, 1965, 1966]: Am. Mus. Novitates, no. 2293, 17 p., illus., 1967.

Recently, VanValen (Palaeontology, v. 8, pt. 4, p. 638–665, 1965; Am. Mus. Nat. History Bull., v. 132, art. 1, p. 1–126, 1966) has suggested that the genus *Apterodon* is not a hyaenodontid, but probably belongs to the family Mesonychidae. This paper re-examines the Fayum collection from Egypt referred to three species of *Apterodon* and compares the evidence with that derived from the mesonychid and hyaenodontid dentition and cranium. Dental nomenclature of VanValen is somewhat modified. In the discussion, the undoubted hyaenodontid affinity of *Apterodon* is confirmed. The few similarities to the mesonychids are the result of superficial convergence to the latter group of mammals. *Apterodon* should be classified in a separate tribe derivable from the proviverrines, whether they are called a subfamily or merely one of the tribes of the Hyaenodontinae.—GDC

Talibudeen, O. *See* Deist, J. 04449

04663 **Tanenbaum, Andrew S.** Clustering of the cosmic ray ages of stone meteorites: Earth and Planetary Sci. Letters, v. 2, no. 1, p. 33–35, table, 1967.

A statistical analysis of the distribution of cosmic ray ages of stone meteorites indicates that significant discrete breakups probably need not be invoked to explain

the apparent clustering of the hypersthene chondrites' ages. The clustering of the bronzite chondrites around 4 m.y. is not statistical.—Author's abstract

Taylor, Charles M. *See* Radtke, Arthur S. 04381

04460 **Taylor, Denis; Kansara, Mohan.** A theory of the nuclear densimeter: Soil Sci., v. 104, no. 1, p. 25–34, illus., tables, 1967.

Since the introduction of the nuclear method of measuring the density of soils, there has been considerable suspicion about the precision of measurement possible with this method. It is suggested in this article that the calibration curve connecting density and instrument response varies with type of soil.—JWH

04790 **Taylor, Edward Morgan.** Recent vulcanism between Three Fingered Jack and North Sister, Oregon Cascade Range [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 953B, 1967.

04520 **Taylor, Hugh P., Jr.** Stable isotope studies of ultramafic rocks and meteorites, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 362–372, tables, 1967.

A first approximation of the stable isotope composition of ultramafic rocks and meteorites is the same. It is particularly true for silicon and sulfur, and least true for hydrogen. The O-18/O-16 ratio of chondrites (excluding the carbonaceous ones) is very similar to that of ultramafics. The C-13/C-12 ratio in rocks is of two types: trace amounts of carbon in chondrites and basalts with the ratio very low; and major concentrations in carbonaceous chondrites, carbonatites, and diamond-bearing kimberlites, in which the ratio is higher. Data suggest that mantle rocks are a C^{13}-rich group, though the problem is still unresolved. The similarity of the O-18/O-16 ratio in basalts, gabbros, and ultramafics indicates that they are genetically related.—HRC

Taylor, Hugh P., Jr. *See* Epstein, Samuel. 04586

04562 **Taylor, Raymond John, Jr.** The relation of forest vegetation to soils and geology in the Gulf Coastal Plain in Oklahoma [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 805B, 1967.

04881 **Terasmae, J.** Reent pollen deposition in the northeastern District of Mackenzie (Northwest Territories, Canada): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 3, no. 1, p. 17–27, illus., tables, 1967.

Surface samples of peat, soil, and lake sediments collected by W. Blake in Bathurst Inlet–MacAlpine Lake area while studying glacial history were examined for pollen grains and spores. The pollen-and-spore assemblages obtained reflect the characteristics of local vegetation and contain a significant component of pine and spruce pollen from a distant source area. The area studied lies 200–250 miles north of the tree-line. A study of peat deposits has indicated that the meteorological factors influencing long-distance dispersal of pollen have remained essentially unchanged for the last 2,000 years. This study also suggests that peat deposition has been extensive only in Late Postglacial time, and commonly an important discontinuity separates the surface peats from the underlying inorganic deposits in the MacAlpine Lake area.—Author's abstract

04528 **Thayer, T. P.** Chemical and structural relations of ultramafic and feldspathic rocks in alpine intrusive complexes, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 222–239, illus., table, 1967.

The world-wide similarity of features in, and relations between, alpine peridotites, podiform chromite deposits, and gabbro can be rationalized only by a common source. Ophiolitic hypotheses could be eliminated by more detailed mapping. Rocks of the alpine mafic magma follow the typical calc-alkaline plutonic trend. Peridotite and gabbro are characterized by metamorphic and igneous textures and structural relations, and were probably emplaced as anhydrous crystal mushes. Details of

the Baltimore Gabbro–State Line Complex in Maryland and Pennsylvania reveal this group is characteristically alpine in nature as it shows similar structural relationships between the gabbro and peridotite.—HRC

04791 **Theodore, Theodore George.** Structure and petrology of the gneisses and mylonites at Coyote Mountain, Borrego Springs, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 954B, 1967.

Thomas, H. H. *See* Philpotts, John A. 04661

Thomas, R. D. *See* Champlin, J. B. F. 04727

04371 **Thompson, C. E.** A spectrophotometric method for determination of traces of platinum and palladium in geologic materials, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575–D, p. D236–D238, table, 1967.

A sensitive method for the determination of traces of platinum and palladium in geologic materials is based on the catalytic effect of these metals on the reduction of molybdophosphoric acid to molybdenum blue using formic acid as the reducing agent. The platinum and palladium are dissolved with hydrobromic acid containing free bromine and are separated from most of the rest of the sample by precipitating with stannous chloride using tellurium as a carrier. As little as 0.05 ppm can be detected, and about 25 analyses can be made per man-day.—Author's abstract

04583 **Thompson, James B., Jr.** Thermodynamic properties of simple solutions, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 340–361, illus., 1967.

Formulas of the Margules type have been shown by several investigators to describe fairly accurately the mixing properties of a variety of solutions. It now appears that even crystalline solutions as nonideal as the alkali feldspars have mining properties that can be accounted for quite satisfactorily by simple asymmetric formulas. These formulas can be extended where necessary to include more parameters and may be modified to deal with multicomponent solutions and solutions with homogeneous reactions.—*from* Author's summary

04405 **Thompson, T. D.; Wentworth, Sally A.; Brindley, G. W.** Hydration states of an expanded phlogopite in relation to interlayer cations: Clay Minerals, v. 7, no. 1, p. 43–49, illus., table, 1967.

A 2–20 μ fraction of phlogopite has been converted to the sodium form by use of sodium tetraphenylboron–NaCl solutions. The cation exchange capacity of the treated material increases to a maximum of about 212 m-eq/100 g, which agrees well with the K_2O+Na_2O content of the initial mineral. Li–, Na–, Ca–, and Mg–saturated forms have been prepared and examined by X–ray diffraction and by thermogravimetric measurements in air, *in vacuo*, and at progressively elevated temperatures. Hydration states corresponding to double water layers are observed for the Mg– and Ca–forms, and to single water layers for the Mg–, Ca–, Na–, and Li– forms. The numbers of water molecules per unit cell and per interlayer cation are considered for the various hydration states.—Authors' abstract

04640 **Tidwell, William D.** A Lower Pennsylvanian flora from Utah and its stratigraphic significance [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 1, p. 237B, 1967.

Tilling, Robert I. *See* Doe, Bruce R. 04626

04474 **Tillman, C. G.** Silicified rhynchonellid brachiopods from beds of New Scotland age (Early Devonian), Virginia and West Virginia: Jour. Paleontology, v. 41, no. 5, p. 1247–1255, illus., 1967.

Acetic acid residues derived from cherty limestone of New Scotland age from Bath and Highland Counties, Va. and adjacent Pendleton County, W. Va., have yielded

large collections of silicified brachiopods. The new genus *Amsdenella* is based on *Rhynchonella abrupta* from the New Scotland Formation of New York. New variation data and illustrations of internal morphology are presented for the following rhynchonellid brachiopods: *Eatonia medialis, Costellirostra singularis, Amsdenella pyramidata* and an undetermined genus and species. *A. pyramidata* is reported from this area for the first time.—Author's abstract

Tilton, G. R. *See* Wetherill, G. W. 04585

Tobish, Othmar T. *See* Nelson, Arthur E. 04590

Towe, Kenneth M. *See* Harper, Charles W., Jr. 04483

04855 **Tozer, E. T.** A standard for Triassic time [with French abs.]: Canada Geol. Survey Bull. 156, 103 p., illus., tables, 1967.

A summary of the data on the sequence and distribution of Triassic ammonoid faunas in Canada is provided. From these data a sequence of 31 ammonoid zones is recognized. The zones are grouped into stages and, where appropriate, substages. In the Lower Triassic, four stages (Griesbachian, Dienerian, Smithian, and Spathian) are recognized; in the Middle Triassic, two (Anisian and Ladinian); in the Upper Triassic, three (Karnian, Norian, and Rhaetian). The sequence of stages, substages, and zones, provides a standard for expressing the age of marine Triassic rocks in Canada. Five new species of ammonoids are described (*Otoceras concavum, Olenikites pilaticus, Gymnotoceras chischa, Progonoceratites poseidon, Trachyceras obesum*).—Author's abstract

04326 **Turekian, Karl K.** Estimates of the average Pacific deep-sea clay accumulation rate from material balance calculations, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 227–244, illus., tables, 1967.

In absence of a large number of radiocarbon dated cores from the Pacific Ocean for comparison with the Atlantic, two methods are discussed for determining average deep-sea clay accumulation rate in the Pacific relative to the Atlantic using material balance calculations. Using the average rate in the Atlantic of 1.1 to 1.2 $g/cm^2/1000$ yr, the "trace element veil" concept of Wedepohl (1960) requires a minimum ratio of Atlantic to Pacific clay rate of 12 to be consistent with data of a Caribbean core; this model is rejected because of inhomogeneous distribution of critical trace elements in the oceans. The calcium carbonate budget can be used to arrive at a minimum ratio of 2.6 for deep-sea clay accumulation rates for the Alantic relative to the Pacific; this ratio can be considerably higher if the rate of $CaCO_3$ accumulation in the Indian Ocean is higher than the Pacific rate.—*from* Author's abstract

Turnbull, W. J. *See* Krinitzsky, E. L. 04426

Turner, William. *See* Kier, Jerry. 04512

04307 **Underwood, Lloyd B.** Classification and identification of shales: Am. Soc. Civil Engineers Proc., v. 93, paper 5560, Jour. Soil Mechanics and Found Div., no. SM6, p. 97–116, tables, 1967.

Shale has been regarded as an undesirable foundation material. A classification distinguishing problem from nonproblem shales is proposed. From an engineering viewpoint, a classification based on physical properties such as compressive strength, peak and residual shear strength, activity ratio, potential swell, elastic modulus, and predominant clay minerals is more useful in predicting in-situ behavior of shale than a geological classification. Shales can be broadly classified into two groups, as compaction or soillike and cemented or rocklike shales. Generally, rocklike shales provide satisfactory foundations with a minimum of problems. Clay shales are the major problem, and in many cases their in-situ behavior is unpredictable and

puzzling in spite of field and laboratory investigations. More research in laboratory and field testing is needed before a completely satisfactory engineering classification can be developed.—*from* Author's abstract

04738 **Upper Mantle Committee Secretariat.** (compiler). International Upper Mantle Project Report 4: Los Angeles, Calif., Internat. Council Sci. Unions, Secretariat of Upper Mantle Comm., 64 p., 1967.

The report presents minutes of the meeting in Tokyo in Aug. 1966, where the planning for Phase III of the Project (1968–70) was done; reports work of a study group on the Andean geophysical program; and summarizes meetings and symposia during the year, and addresses of members of various committees. An appendix discusses detailed resolutions on multidiscipline regional studies, deep drilling for scientific purposes, world rift system, and continental margins and island arcs.—ESL

04532 **Upton, B. G. J.** Alkaline pyroxenites, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 281–288, table, 1967.

Alkaline pyroxenites and related ultramafics occurring in alkalic intrusive ring complexes are reviewed. They are often found in alkalic volcanic fields on cratonic areas. Several, including that at Magnet Cove, Ark., are reviewed petrologically. A concentric-zoned pattern in cylindrical or funnel-shaped intrusions is common. Many have well-developed gravity stratifications in early stages, which are often obscured by fenitization and recrystallization when the late stage liquids become enriched in alkalis and volatiles. Late stages produce a carbonatite residuum. Pyroxenites and related peridotites form bombs, and the like. Ultramafic and ultrabasic rocks are usually formed by fractional crystallization of alkalic, undersaturated magmas such as olivine melilitite. Many analyses are included.—HRC

04301 **U.S. Geological Survey.** Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D1–D296, illus., tables, 1967.

This collection of 48 papers (44 cited separately) contains results of geologic studies—paleontology, stratigraphy, and structural geology; geophysics, mineralogy and petrology, remote sensing, geochronology, paleomagnetism, volcanology, economic geology, earthquakes, marine geology, glacial geology, sedimentation and soils, and analytical methods; hydrologic studies—coastal geohydrology, engineering hydrology, quality of water, and surface water; and topographic studies—photogrammetric equipment and map base plotting.—MCM

04875 **U.S. Geological Survey.** Geological Survey research 1967, Chap. A: U.S. Geol. Survey Prof. Paper 575-A, p. A1–A377, illus., 1967.

This volume summarizes results of investigations during 1966 by the U.S. Geological Survey of natural resources, geology and hydrology applied to engineering and public health, regional geology, geologic and hydrologic work in other countries, principles and processes, topographic surveys and mapping, and computer technology. Additional information includes publications program, cooperators during fiscal year 1967, Geological Survey offices, investigations in progress in Geologic, Water Resources, and Conservations Divisions, contents of chapters B, C, and D of Geological Survey research 1967, publications by Survey authors during fiscal 1967, and indexes.—MCM

04451 **VanHeerden, W. L.; Grant, F.** A comparison of two methods for measuring stress in rock: Internat. Jour. Rock Mechanics and Mining Sci., v. 4, no. 4, p. 367–382, illus., tables, 1967.

As part of an extensive program of measuring rock stresses, a series of comparative measurements were made in a Canadian uranium mine by means of a strain cell developed at the South African Council for Scientific and Industrial Research and of a borehole deformation meter developed at the U.S. Bureau of Mines. An analysis of the results, taking account of certain sources of error, shows that there is satisfactory agreement between the results obtained with the two methods.—Authors' abstract

04357 **VanHorn, Richard.** Soils on Upper Quaternary deposits near Denver, Colorado, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D228-D232, illus., 1967.

A study of soil-stratigraphic relationships along Indian Creek south of Denver, Colo., suggests that a previously unrecognized possible soil-forming interval occurred soon after deposition of the Broadway Alluvium and prior to renewed downcutting and deposition of the next younger pre-Piney Creek alluvium. This indicates that four intervals of soil-profile development took place in Wisconsin and Recent time, instead of three such intervals as previously recognized. The informal designation of early Recent soil should be applied only to the soil that developed after deposition of the pre-Piney Creek deposits.—Author's abstract

VanReenan, E. D. *See* Moody, D. W. 04361

04312 **Vemuri, Venkateswararao; Dracup, John A.** Analysis of nonlinearities in ground water hydrology—A hybrid computer approach: Water Resources Research, v. 3, no. 4, p. 1047-1058, illus., 1967.

A hybrid computer method to solve nonlinear partial differential equations describing the flow of fluids in underground formations is described. Using finite difference methods, the problems are first programmed by a flow chart for a pure digital computer solution. Because the ability of resistance networks to solve a set of simultaneous equations instantaneously is recognized, major matrix inversion subroutines in the digital flow chart are replaced by analog resistance network hardware. Incorporation of analog hardware drastically reduces the computation time involved in inversion of large matrices. The resistance network constructed on an analog computer patch board allows an unparalleled flexibility not available in a digital computer.—Authors' abstract

Verhoogen, J. *See* Grommé, C. S. 04300

Vian, R. W. *See* Heinrich, E. William. 04452

Wade, Mary E. *See* Bandy, Orville L. 04331

04717 **Waldron, Howard H.** Geologic map of the Duwamish Head quadrangle, King and Kitsap Counties, Washington: U.S. Geol. Survey Geol. Quad. Map GQ-706, scale 1:24,000, section, 1967.

04382 **Walker, George W.** Contraction jointing and vermiculitic alteration of an andesite flow near Lakeview, Oregon, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D131-D134, illus., 1967.

A thick olivine andesite flow near Lakeview, Oreg., is characterized by a well developed reticulate polygonal system of contraction joints that controlled subsequent moderate- to low-temperature deuteric or hydrothermal alteration. Development of the joints, shortly after flowage ceased, permitted volatile constituents of the lava to escape into them, which resulted in rapid chilling adjacent to joints and formed dense impervious selvages. The selvages acted as effective seals to the exsolving volatiles, which reacted with andesite within the polygonal cells and converted olivine to expandable-lattice vermiculite and magnetite(?).—Author's abstract

Walker, J. W. *See* Pearce, D. C. 04345

Walker, William M. *See* Gibson, Thomas G. 04455

04385 **Wallace, R. E.; Moxham, R. M.** Use of infrared imagery in study of the San Andreas fault system, California, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D147-D156, illus., 1967.

Infrared imagery (in the 8- to 13-micron band) of the San Andreas fault system in the Carrizo Plain area of California shows that the fault can be clearly traced over most of about 200 miles flown. Variations in soil moisture caused by the water-barrier characteristics of the fault zone, as well as vegetation differences related to soil moisture and microtopography, are factors influencing visibility of the fault in the IR imagery. Also identified on the imagery and useful in analyzing offset on the fault are (1) offset segments of ancient stream channels disrupted by movement on the fault, (2) landslide terrain, and (3) numerous soil and Tertiary bedrock units. Imagery obtained 1-2 hours before sunrise is considered most useful for the fault studies.—Authors' abstract

Walton, E. K. *See* Duff, P. McLaren D. 04714

Wanek, A. A. *See* Read, Charles B. 04337

04359 **Ward, F. N.; Nakagawa, H. M.** Atomic absorption determination of bismuth in altered rocks, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D239-D241, tables, 1967.

Small amounts of bismuth in altered rocks are determined by atomic absorption spectrophotometry after samples are treated with boiling nitric acid. This treatment solubilized most of the bismuth in the materials being investigated, and the acid solution is atomized directly into an acetylene-air flame without prior enrichment or preconcentration. As little as 10-20 ppm of bismuth can be measured with a relative standard deviation of about 10 percent. The accuracy is comparable to that existing in colorimetric and spectrographic methods. All these features coupled with the speed and simplicity commend the proposed method for scanning large numbers of geologic samples in geochemical exploration programs and related investigations.—Authors' abstract

04712 **Ward, William C.** Shelf islands of northeast Quintana Roo, Mexico, *in* Yucatán field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7: New Orleans, La., New Orleans Geol. Soc., p. 124-136, illus., 1967.

On the narrow continental shelf of northeastern Quintana Roo, Yucatán Peninsula, calcarenite ridges form four small islands: Isla Contoy, a double-ridged island with cliffs and dunes; Isla Blanca, a barrier of sand dunes and beaches across calcarenite-crusted Pleistocene dune ridges; Isla Mujeres, with three ridges of Pleistocene eolian limestone intersected by two younger ridges; and Isla Cancun, with cliffs of oosparite and hooked to the mainland by dune rock and by indurated storm ridges.—GDC

04821 **Warren, Harry V.; Delavault, Robert E.** Geochemical prospecting has now come of age: Northern Miner, v. 53, no. 36(1141), p. 49, 57, illus., 1967.

Soil and stream sediment sampling were the first geochemical tools to win any support in North America. In the early days, several mines were discovered, but mistakes were made also. Other aspects of geochemistry which the mining industry is failing to apply are discussed, especially biogeochemistry. The Ice Age was too recent for new species to evolve in Canada, and the mantle of drift too heavy for geobotany to be useful. However trees and plants contain in their makeup elements representative of a large soil sample, and can be used for finding ore-trains. Some plants have an affinity for molybdenum and arsenic. Problems in developing geochemical prospecting are mentioned; these are similar to those of geophysics in its early days.—ESL

Wasserburg, G. J. *See* Burnett, D. S. 04656

Wasserburg, G. J. *See* O'Connell, Richard J. 04863

04494 **Waters, Ronald Hobart.** The effect of porosity on shearing resistance and thermal conductivity for amorphous soils in vacuum [abs.]: Dissert. Abs., Sec. B, Sci. and Eng.,v. 28, no. 3, p. 895B, 1967.

04750 **Watkins, Joel S.; Godson, Richard H.; Watson, Kenneth.** Seismic detection of near-surface cavities: U.S. Geol. Survey Prof. Paper 599-A, p. A1-A12, illus., table, 1967.

Oscillations with durations of 1 sec or more and with narrow frequency bands have been observed over cavities in lava and alluvium at depths ranging from 1 to 14 m; they are probably primarily radial oscillations of cavity walls, and calculations show that dominant frequencies are generally within a factor of 3 of those computed from Biot's theoretical results for radial oscillations of a cylindrical hole in an infinite solid. Delays in arrival times and anomalous attenuation of seismic waves traversing cavities have also been observed. Fractured and broken rock in the chimney above a nuclear explosion cavity is thought to be responsible for delays in Rayleigh waves and delays in trapped waves. Fourier analysis and autocorrelation have been used to detect these and similar resonant phenomena in noisy backgrounds; cross correlation of proximate traces was less successful for this purpose.—Authors' abstract

04400 **Watson, G. S.; Beran, R. J.** Testing a sequence of unit vectors for serial correlation: Jour. Geophys. Research, v. 72, no. 22, p. 5655–5659, tables, 1967.

In the paleomagnetic study of superimposed strata, the NRM directions from adjacent horizons may appear to be more alike than those from different depths. A statistical test is, therefore, required for short-range or serial correlation of directions. The statistic proposed in this paper is the sum of the cosines of the angles between directions at adjacent points in the sequence. The observed value of the statistic is compared with its randomization distribution, so that the test makes no distributional assumptions and should be widely applicable.—Authors' abstract

04515 **Watson, K. D.** Kimberlites of eastern North America, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 312–323, illus., tables, 1967.

Peridotite, mica peridotite and kimberlite occur in small dikes and sills a few feet wide, and from ten to a few hundred feet long, mostly along a trend from Pennsylvania to Arkansas, with a few in Quebec. They are on the stable craton and are nonorogenic or postorogenic. All are Mesozoic except in Quebec where they are Precambrian. Emplacement temperatures are less than 600°C. Their chemistry resembles that of Swedish, African, and Siberian kimberlites, and is unlike that of the alpine-type ultramafics. Calcite is present and is shown to be primary; the magmas were very fluid. Many analyses are included. Their close association with cryptovolcanic structures is noted.—HRC

04530 **Watson, K. D.** Kimberlite pipes of northeastern Arizona, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 261–269, illus., tables, 1967.

Rubble pipes at Garnet Ridge are described petrographically and geologically. Great varieties of xenoliths, both in stratigraphy and in size, are engulfed in serpentine with a generally circular plan. Some stratigraphically recognizable blocks have risen several thousand feet. Eclogite is also known. Moses Rock and Mule's Ear, nearby in Utah, are similar. At Buell Park, Ariz., kimberlite tuff is mapped and described petrographically; it is purplish-brown to olive green, fine grained, and contains many xenoliths of local sandstone. The matrix is olivine, enstatite, chromian diopside, pyrope, magnetite, abundant serpentine, and others. A variety called lapilli tuft is also recognized. The maximum age is late Cretaceous, and some bodies intrude Pliocene rocks.—HRC

Watson, Kenneth. *See* Watkins, Joel S. 04750

04509 **Weed, S. B.** Competitive adsorption of organic cations on layer silicates [abs.]: Elisha Mitchell Sci. Soc. Jour., v. 83, no. 3, p. 177, 1967.

Weidie, A. E., Jr. *See* New Orleans Geological Society. 04719

Weidie, A. E., Jr. *See* Bonet, F. 04825

04829 **Weidie, A. E., Jr.; Murray, Grover E.** Geologic road log, Campeche to Champoton, *in* Yucatán field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7: New Orleans, La., New Orleans Geol. Soc., p. XVI–XIX, reprinted 1967; originally published 1962.

04830 **Weidie, A. E., Jr.; Murray, Grover E.** Geologic road log, Merida to Campeche, *in* Yucatán field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7: New Orleans, La., New Orleans Geol. Soc., p. VII–XV, reprinted 1967; originally published 1962.

Weisbrod, Alain. *See* Kern, Raymond. 04845

Weller, W. W. *See* King, E. G. 04728

04477 **Wells, John W.** The Devonian coral *Pachyphyllum vagabundum*, a necroplotic *P. woodmani*?: Jour. Paleontology, v. 41, no. 5, p. 1280, 1967.

Pachyphyllum vagabundum, based upon the only colonial rugose coral yet found in the clastic Upper Devonian rocks of New York, is believed to be a colony of the common *P. woodmani* of the Iowa Devonian that was transported by flotation from Iowa to New York. Such flotation is known in the case of some modern reef corals.—Author's abstract

Wentworth, Sally A. *See* Thompson, T. D. 04405

Werts, L. L. *See* Read, Charles B. 04631

04721 **West, Robert C.** Physical geography of the Yucatán platform, *in* Yucatán field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7: New Orleans, La., New Orleans Geol. Soc., p. 58–63, illus., reprinted 1967; originally published 1962.

West, S. W. *See* Baltz, Elmer H. 04410

West, Walter S. *See* Cohee, George V. 04589

04585 **Wetherill, G. W.; Tilton, G. R.** Geochronology, *in* Researches in geochemistry, V. 2 (Philip H. Abelson, editor): New York, John Wiley and Sons, p. 1–28, illus., 1967.

One of the important frontiers in recent research has been the extension of radiometric techniques to samples less than a few million years in age. Theoretical considerations are discussed and the application divided into dating young sediments, methods applicable to Pleistocene igneous rocks, and the application of Rb-Sr chronology to metamorphic rocks. Comments are given on the carbon-14; uranium-ionium, unsupported Th-230, Pa-231, and Pa-231/Th-230; U 238/U234 disequilibrium; helium; K-Ar; and Be-10 methods for sediments. Discordant lead ages are discussed.—ESL

Whetten, John T. *See* Lister, C. R. B. 04407

04647 **White, Donald E.** Mercury and base-metal deposits with associated thermal and mineral waters, [Chap.] 13 *in* Geochemistry of hydrothermal ore deposits (H. L. Barnes, editor): New York, Toronto, and London, Holt, Rinehart and Winston, p. 575–631, illus., tables, 1967.

Waters associated with mercury and base-metal deposits are characterized by relatively high contents of Na, HCO_3, B, and NH_4, and by neutral pH's. Proposed mechanisms for mercury transport and deposition are reviewed. Chemical analyses of waters associated with 21 deposits of mercury and base metals, and minerals from 14 mercury-containing deposits are tabulated and the areas described. They include ten from California, two each from Nevada and Colorado, and one each from Idaho, Utah, and Michigan. The Steamboat Springs area, Nev., where metals are still being deposited, is treated extensively. Na-Ca-Cl brines competent to dissolve base metals can form as late-stage magmatic brine, connate waters heated

after deep burial or close proximity to a thermal anomaly, or meteoric water that has dissolved evaporites and then reacts with rocks in a geothermal environment.—ESL

White, John S., Jr. *See* Yochelson, Ellis L. 04376

Wilcoxon, J. A. *See* Bramlette, M. N. 04415

04324 **Wiles, William W.** Pleistocene changes in the pore concentration of a planktonic foraminiferal species from the Pacific Ocean, *in* Progress in oceanography—V. 4, The Quaternary history of the ocean basins: London and New York, Pergamon Press, p. 153–160, illus., 1967.

Pore concentration per unit area on the test wall surfaces of *Globigerina eggeri* shows marked changes through time. In Atlantic and Caribbean core samples the changes correlate with Pleistocene climatic variations, as established by faunal analyses and oxygen–18 studies. High counts per unit area occur during interglacial ages and low counts during glacial ages. Pore concentration counts of *G. eggeri* from a Pacific Ocean core taken north of Easter Island show similar changes through time, presumably relating to Pleistocene ages; however, there are no marked faunal variations in the core, suggesting that the Pacific Ocean remained warm throughout the Pleistocene. Evidently pore concentration in this species is a response to a Pleistocene environmental change other than temperature.—*from* Author's abstract

Wilkie, Lorna C. *See* Cohee, George V. 04589

04375 **Willden, Ronald; Kistler, Ronald W.** Ordovician tectonism in the Ruby Mountains, Elko County, Nevada, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575–D, p. D64–D75, illus., 1967.

Lower Paleozoic rocks in the southern Ruby Mountains, northeastern Nevada, have undergone two periods of tight folding that did not affect the middle and upper Paleozoic rocks of the range. The two structural terranes are separated by a surface of discontinuity interpreted to be an angular unconformity. Stratigraphic evidence indicates that the lower Paleozoic deformation, which was accompanied by at least some regional metamorphism and plutonism, took place between Early Ordovician and Silurian time. Strong deformation of early Paleozoic age has not previously been recognized in the Great Basin.—Authors' abstract

Williamson, W. O. *See* Faruqi, F. A. 04406

Willingham, Robert W. *See* McCaleb, James A. 04430

04466 **Wilson, Edward C.** Primary type-material of the Early Permian archaeogastropod *Omphalotrochus whitneyi* (Meek, 1864): Jour. Paleontology, v. 41, no. 5, p. 1113–1115, illus., 1967.

The lectotype and three paralectotypes of the Early Permian archaeogastropod *Omphalotrochus whitneyi* from the McCloud Limestone of northern California are in the Museum of Comparative Zoology, Harvard University. The lectotype, figured photographically for the first time, clearly shows the existence, previously questionable, of a sinus on the outer lip. Recovery of these specimens is of significance because *O. whitneyi* is type species of the genus, which in turn is type genus of the Family Omphalotrochidae, Knight, 1945.—*from* Author's abstract

04686 **Wilson, J. T.** Some implications of new ideas on ocean-floor spreading upon the geology of the Appalachians, *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 94–99, illus., 1967.

Cyclic reversals of the Earth's magnetic field can explain the regular pattern of magnetic anomalies parallel to midocean ridges if the ocean floors are expanding and being imprinted magnetically by the reversals, and provide a precise time scale for continental drift. The rate of drift cannot be accounted for unless as some oceans spread others diminished, presumably by absorption into trenches and

beneath island arcs. It is suggested that a proto-Atlantic Ocean closed during early Paleozoic time along a series of island arcs that lay off the east coast of North America, and did not reopen until the end of the Jurassic. "Atlantic" and "Pacific" faunal realms were merged during the closure, and alternating examples of these are found along both coasts of the present ocean. The underlying Precambrian basement rocks also differ in age with respect to the faunal realms.—VMJ

04364 **Wilson, K. V.** A preliminary study of the effect of urbanization on floods in Jackson, Mississippi, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D259-D261, illus., 1967.

Comparison of flood-frequency curves for three streams near Jackson, Miss., based on annual maximum floods for the period 1953-66, and for another stream for a shorter period, indicates that the mean annual flood for a totally urbanized basin is about 4 1/2 times that of a similar rural stream. It further indicates that the 50-year flood for such an urbanized basin is about three times that of a rural stream.—Author's abstract

04865 **Wilson, Richard Leland.** The Pleistocene vertebrates of Michigan: Michigan Acad. Sci., Arts and Letters Papers 1966, v. 52, p. 197-234, illus., tables, 1967.

This study includes only specimens that have been recorded by museums in Michigan prior to January 1965. Pleistocene vertebrates are restricted to the time that began with retreat of the Valparaiso sheet, exposing the southern part of the State. Ice was thicker in the Great Lakes area to the east so that was covered longer. The systematic discussion covers the Classes Osteichthyes, Reptilia, and Aves, and seven orders of Mammalia. Possible age correlation by associations and radiocarbon dating and pollen analysis are discussed and tabulated. The complexities of Wisconsin biogeography provide a broadened basis for the study of older fossil deposits. The fauna and flora may have changed much more rapidly then, but the changes are preserved for study.—ESL

04792 **Wold, Richard John.** Development of a digital recording magnetometer system and its application to the western Lake Superior region [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 954B, 1967.

04486 **Wolleben, J. A.** Senonian (Cretaceous) Mollusca from Trans-Pecos Texas and northeastern Chihuahua, Mexico: Jour. Paleontology, v. 41, no. 5, p. 1150-1165, illus., tables, 1967.

Senonian rocks in Trans-Pecos Texas and adjacent Chihuahua contain representatives of the ammonite families Diplomoceratidae, Collignoniceratidae, and Placenticeratidae and the pelecypod family Ostreidae. From these families 13 genera, 23 species (one new), and 5 subspecies (two new) are recorded herein from the Ojinaga and San Carlos Formations. [No pelecypods are discussed in text.]—*from* Author's abstract

Wright, R. P. *See* Kellum, L. B. 04856

Wright, W. B. *See* Carr, M. S. 04736

04338 **Wyllie, P. J.; Biggar, G. M.** Fractional crystallization in the 'carbonatite systems' $CaO-MgO-CO_2-H_2O$ and $CaO-CaF_2-P_2O_5-CO_2-H_2O$, *in* I.M.A. Volume—Internat. Mineralog. Assoc., 4th Gen. Mtg., 1964, Papers and Proc.: New Delhi, Mineralog. Soc. India, p. 92-105, illus., table, 1966[1967].

The relations in the experimental systems are discussed. Melting temperatures are well within the magmatic range. Apatite and calcite can crystallize simultaneously over a wide range of pressures and temperatures (as low as 575°C), and a carbonate liquid containing more than a few percent of P_2O_5 would precipitate apatite before calcite. The results support a magmatic origin of carbonatites.—MF

Wyllie, P. J. *See* Franz, G. W. 04516

04544 **Wyllie, P. J.** (editor). Ultramafic and related rocks: New York and London, John Wiley and Sons, 464 p., illus., tables, 1967.

This book was planned for advanced students, research workers, petrology teachers, and enthusiastic undergraduates; it should be of interest also to solid-earth geophysicists because the International Upper Mantle project has focused attention on implications of ultramafic rock studies for interpretations of upper mantle composition and mineralogy. The editor has written an introduction to each of the 12 major chapters which are divided into 41 sections by 33 authors; 34 papers are cited separately. A comprehensive bibliography is included.—MCM

Wyllie, P. J. *See* Boettscher, A. L. 04646

04557 **Yeh, William Wen-Gong.** Moisture movement in a horizontal soil column under the influence of an applied pressure [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 895B, 1967.

04376 **Yochelson, Ellis L.; White, John S., Jr.; Gordon, Mackenzie, Jr.** Aragonite and calcite in mollusks from the Pennsylvanian Kendrick Shale (of Jillson) in Kentucky, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D76–D78, table, 1967.

In X-ray studies of a representative of each of 18 molluscan species to determine the mineral composition of the shell, three genera of cephalopods, nine genera of gastropods, and three genera of pelecypods show only aragonite in the shell. Two genera of pelecypods show an outer shell layer of aragonite and calcite. One gastropod genus has an outer calcitic shell layer and an inner aragonitic layer.—Authors' abstract

04435 **Young, R. A.** Dependence of apatite properties on crystal structural details: New York Acad. Sci. Trans., ser. 2, v. 29, no. 7, p. 949–959, illus., tables, 1967.

Atomic-scale mechanisms and effects of substitution are particularly important in biological apatites. Because of their great similarity, hydroxyapatite, fluorapatite, and chlorapatite are used as a system to demonstrate the important influence of structural details on physical properties. The monoclinic chlorapatite, as well as the other two, can be described in terms of the usual hexagonal structure. Examples selected for discussion of physical properties affected by the choice of X ions are lattice parameters, crystal symmetry, and dielectric and optical properties.—ESL

04442 **Zachariasen, W. H.** A general theory of X-ray diffraction in crystals: Acta Cryst., v. 23, pt. 4, p. 558–564, illus., 1967.

A general theory of X-ray diffraction in a finite crystal is developed on the basis of an approximate treatment of the coupling between incident and diffracted beams. The theory leads to a universal formula for the integrated intensity of the diffracted beam, valid over the entire range from the perfect to the ideal mosaic crystal. The application of the theory to the mosaic model of a real crystal yields C. G. Darwin's theory of secondary extinction when the perfect domains are in poor alignment, in which case the half width of the distribution function for the orientation of the domains can be obtained experimentally. However, the general theory gives a new intensity formula if the domains are in good alignment. The intensity dependence upon wave length is different, and experiment will give the mean radius of a perfect domain.—Author's abstract

04869 **Zakrzewski, Richard J.** The primitive vole, *Ogmodontomys*, from the late Cenozoic of Kansas and Nebraska: Michigan Acad. Sci., Arts and Letters Papers 1966, v. 52, p. 133–150, illus., tables, 1967.

A systematic study of the primitive vole, *Ogmodontomys*, reveals morphological trends of evolutionary significance. Analyses of these trends, i. e. increase in tooth length and hypsodonty, development of dentine tracts and the degree of closure of the alternating triangles, provide a basis for the relative dating of the localities at which *Ogmodontomys* is found in southwestern Kansas. These trends also permit the naming of a new subspecies, *Ogmodontomys poaphagus transitionalis*. The intermediate nature of this form, combined with the findings of Hazard (1961) and

Taylor (1960) for material at Loc. UM-Kl-47, permits the removal of the fauna in this locality from the Rexroad local fauna proper and the consideration of it as a distinct and older local fauna, the Fox Canyon.—Author's abstract

04880 **Zakrzewski, Richard J.** The systematic position of *Canimartes*? from the Upper Pliocene of Idaho: Jour. Mammalogy, v. 48, no. 2, p. 293–297, tables, 1967.

Based on similarities of the dentition, especially the diagnostic triangular shape and development of the slight cingular shelf on the P4 and the notched protoconic crest of the M1, *Canimartes? idahoensis* (Gazin, 1937) and *C.? cookii* (Gazin, 1937) [both from the Glenns Ferry Formation of southern Idaho] are assigned to the genus *Trigonictis*. Statistical analyses of various parameters in certain Recent mustelids show that although sexual dimorphism can account for great differences in size, comparison with the results obtained for the fossil forms seems to indicate that *Trigonictis idahoensis* (Gazin) and *T. cookii* (Gazin) are valid species.—Author's abstract

04386 **Zartman, R. E.; Stern, T. W.** Isotopic age and geologic relationships of the Little Elk Granite, northern Black Hills, South Dakota, *in* Geological Survey research 1967, Chap. D: U.S. Geol. Survey Prof. Paper 575-D, p. D157–D163, illus., tables, 1967.

The Little Elk Gneissoid Granite of Taylor (1935) in the northern Black Hills, S. Dak., first crystallized 2,560 m.y. ago and was disturbed about 60 m.y. ago, during Laramide time, as interpreted from isotopic ages of five zircon separates. Twelve total-rock Rb–Sr analyses show that extensive open-system conditions have occurred since granite emplacement within the pluton; however, the granite as a whole seems not to have undergone net exchange with its enclosing rocks. Whether all of this element redistribution within the pluton took place in Laramide time, or partly during some Precambrian event, has not been established. Field relationships suggest that the contact between the granite and adjacent Precambrian metasedimentary rocks is an unconformity, although the possibility of a conformable intrusive contact cannot be ruled out.—Authors' abstract

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